A THEORETICAL BASIS

OF

HUMAN BEHAVIOR

BY

ALBERT PAUL WEISS, PH.D.

PROFESSOR OF PSYCHOLOGY
OHIO STATE UNIVERSITY

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TO

MAX F. MEYER

PREFACE

In this book I have tried to be of service to three classes of readers: (1) The psychologists, social theorists, philosophers, and biologists, for whom behaviorism is of *systematic* interest; (2) The various investigators in the medical group for whom behaviorism is of *practical* interest; (3) That larger group of writers, educators, and statesmen, for whom behaviorism is of *general* interest.

To undertake such a task may seem the height of presumption, and I am not unprepared to have this conclusion heartily endorsed by my critics. My justification for attempting this task lies in the widespread interest that has developed in the subject of behaviorism, and the diversity of opinion as to what it actually represents. Holding, as it does, a buffer position between the biological and social sciences, its ramifications are necessarily wide, and when it further extends itself, or rather is extended, into the still wider circles of religion, literary and art appreciation, statesmanship, and social reform, some attempt should be made to establish its position both with respect to content and methodology. Whether behaviorism is regarded as a phase in the development of psychology or biology, there can be no doubt that the methods and principles of the natural sciences as represented by mathematics, chemistry, physics and biology, are displacing the anthropomorphism, intuitionism, which in the past have moulded social organization and defined our individual responsibility. Is it not about time that the brain and nervous system are accepted as biological phenomena and that the distinction between vegetative and vital processes be dropped? Perhaps behaviorism is

only another name for such a general scientific expansion into social problems. It seems so to me, and this is the reason I have enlarged its scope beyond that of a special science even though I realize that further analyses and reclassifications must be contributed by the investigators from many fields which I can approach only as an interested amateur.

I assume on the part of my readers a degree of familiarity with scientific and social problems which will enable them to readily follow discussions in which the specialist's technology and terminology have been simplified into the vocabulary of the educated man not trained in special fields.

There are many critics of behaviorism, but the contradictory inferences that have been drawn from my own contributions have made me slow to criticize others. For many contributors, and very able ones, too, behaviorism is their *emotional* reaction against an irritating vagueness in psychology and sociology. Until this attitude has spent its force, it seems to me that *time* is the most effective critic.

With reference to the work of the two psychologists most frequently identified with the behaviorist point of view, Max F. Meyer and John B. Watson, I believe I am in complete agreement on essentials. Meyer's explanation of human behavior by the aid of mechanical analogies and the theoretical conceptions which he has introduced have received such scant consideration that it is very evident that the modern conceptions of science as found in mathematics, physics, and chemistry are still far from being second nature to most psychologists, and especially to that large group of writers who claim to be behaviorists of varying degrees of intensity.

PREFACE

The criticisms that have been directed against Dr. Watson's writings have taught me the difficulty which onfronts any one who tries to demonstrate that the *complete* explanation of human behavior does not require a 'unique psychic" factor any more than does geology. When Watson maintains that he will not discuss consciousness, this is generally interpreted by psychologists o be an arbitrary elimination of the essential part of uman behavior. To these it seems as if the behaviorsts ignore consciousness because it is too difficult, or ecause it is a phase in the study of human behavior vith which they do not wish to be bothered. Of course, o such inference is warranted. Behaviorism claims to ender a *more* complete and a *more* scientific account of uman achievement *without* the conception of consciousness, than traditional psychology is able to render *with* it. The factors which traditional psychology vaguely lassifies as conscious or mental elements merely *vanish* vithout a remainder into the biological and social components of the behavioristic analysis.

Wherever controversy in science is heated there arises he need for a judicial weighing of the respective claims nd an insistence upon a recognition of similarities, which eem to be differences. For psychology Professor H. C. Varren has undertaken this rather thankless and often mbarrassing task. He is forcing contemporary psyhologists irrespective of whatever their systematic status nay be, to scrutinize their fundamental assumptions and s insisting upon some degree of consistency in the develpment of the superstructure. Doctor Warren's developnent of the "double-aspect" view, has made it posssible o draw the distinction between behaviorism and tradiional psychology with a degree of clearness that will do

a great deal toward settling the controversy either one way or another.

Among the more recent writers I wish particularly to express my apreciation to E. K. Lashley, J. R. Kantor, and W. S. Hunter. The debt which a teacher owes to the criticism of his students is beyond evaluation, but among the many who should be mentioned E. A. Esper, C. Landis, P. R. Farnsworth, K. C. Pratt, have been most helpful. To my wife I am indebted for constant assistance in preparing the manuscript and for a wholesome criticism of form and content. Finally I wish to express thanks to the Psychological Review Publishing Company for permission to reprint parts of articles which appeared in earlier issues of their publications.

ALBERT P. WEISS.

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INTRODUCTION

The behavioristic point of view as a working hypothesis to explain the facts of individual and social attainment is the basis of much discussion and controversy.

There is scarcely a number of the psychological, philosophical, or sociological journals but has its article for or against behaviorism. From the extreme point of view that behaviorism will corrupt the youth of the land and give sanction to the grossest self indulgence, it is possible to pass by easy stages to the mildly expressed conviction that behaviorism is only the older physiological aspect of traditional psychology.

Traditional psychology, through introspection, and philosophy through speculation, have given the study of the individual such a restricted interpretation that an impassable barrier has been created between the individual and the world in which he lives. The unique and intimate mental processes which introspection is said to reveal do not square in importance with what man has actually achieved. If all of the *sensations*, *images*, and *feelings* of all the great men in history had been minutely recorded

after the manner of an approved introspective technique, it would add not one jot or tittle to our understanding of the enormous changes which man has introduced into his environment and into his own manner of living. The individual is a part of the universe in which he lives, interacting with other individuals and with his environment to produce what we call civilization. To understand human achievement, psychology must do more than scrutinize man as he is at a given instant. It must assume that he is the product of biological, anthropological, and social antecedents as definitely causal in character, as the forces in physics and chemistry. Traditional psychology has developed its classifications of man's so-called mental properties before the causes of his bodily movements were known, and these mental properties are now so foreign to the physical contributions made by the biological sciences that they cannot be integrated into the finely balanced system of natural law and order which is gradually being established.

The theory of organic evolution in biology, and man's anatomical and physiological resemblance to the animals, have raised the question whether man's attainments are not better understood as biological (as opposed to psychical) forces. In conformity with this conception man's mental states or processes are being regarded more and more as mechanistic

in character. But in the face of all attempts to restrict the use of such terms as willing, intellect, and emotion, to their academic limitations, uncritical popular psychology has endowed them with causal properties which are repudiated by the psychologists.

In the interest of his own science and of those sciences for which human endeavor is the important datum, the behaviorist must analyze the phenomena to which such terms as consciousness, mind, awareness, have been applied, even though such an analysis will prove disappointing to those who would like to regard human achievements as a manifestation of some thrilling, awe-inspiring psychical energy.

Behaviorism at present is merely a convenient term which more or less definitely separates those psychologists who believe that the so-called mental states cannot be classified as physical states, from those psychologists who believe that they can. This differentiation in psychology and so far as it has been introduced into sociology has developed a conception of *social* evolution that has changed the direction of individual and social research, and is establishing a different conception of the causes of human achievement and of the interrelations of individuals. What is demanded of psychology today is a set of principles which account for man's accomplishments as the result of his participation in the social life about him, and which are substitutes for the

vague principles represented by such terms as image, thoughts, hopes, and aspirations. To ascribe man's achievements to the operation of personal wants and desires, ignores the fundamental question of how a desire can *control* action. The demands of science and of every day life are asking for principles of control, not for the analysis of what traditional psychology describes as mental phenomena. Our *non-psychological* lives are crowded with such terms as intellect, reason, desire, will, emotion. As *psychologists* we may learn to use these terms rather consistently and skillfully, and before our students quite impressively. But when these students in later life surprise us by dropping back into the uncritical popular use of the terms and give them as the *causes* of their adjustments to the situations of daily life, we may wonder whether the fine-drawn distinctions we have so laboriously taught them, actually correspond to the classification and analyses which arise out of the practical conditions of social interaction.

So firmly, however, have such subjective terms as thought, imagination, vision, etc., been introduced as causes of social reforms and of social progress that it is exceedingly difficult to pass directly into a behavioristic interpretation of civilization. The following type of question often confronts the teacher of the behavioristic standpoint: "If, as you say, what I call mental processes or consciousness do not actually

control the muscles by which I make my adjustments to my environment, then what does? If awareness, mind, will, desire, are not to be regarded as a form of energy which in some way exerts a selective action upon the situation with which I am confronted and upon my responses to them, what is the behavioristic equivalent of the conditions for which these terms stand? I know that I am a part of a complex social organization; I know that my presence in this organization has changed it somewhat, and has changed me more. I ascribe these changes to reason, to intelligence, some of them to stupidity. Every one does it, every one seems content with these methods. If it is all an illusion, if what seems to me to be a very definite teleological trend toward a personalistic destiny, is only an obscure mechanization from which there is no escape, why give any concern for my own and the welfare of others?" Questions such as these are not limited to the uneducated. They represent actual problems for the best writers, statesmen, sociologists, moralists, and theologians.

For the writer, behaviorism in psychology is merely the name for that type of investigation and theory which assumes that man's educational, vocational, and social activities can be completely described or explained as the result of the same (and no other) forces used in the natural sciences. I

believe that behavioristic psychology will be recognized as an interlocking segment through which the social sciences will become an extension of the natural sciences. As an educational problem our whole conception of science will probably change. Physical science has not seriously interfered with traditional beliefs of either the educated or uneducated; biological science and the theory of organic evolution in particular has been widely accepted by the educated and is beginning to be accepted by the uneducated; the social science of the future will introduce the conception of *social evolution* which will brand as illusion and error a much greater percentage of long cherished beliefs and ideals, but this sacrifice is now scarcely *anticipated* by the educated and is entirely *unsuspected* by the masses of mankind.

This book is an attempt to bridge over the gaps between traditional, popular, and behavioristic psychology by showing their interrelations. The underlying plan of the book is to present the fundamental principles of behaviorism as the writer sees them, and to compare them with the most important conceptions in traditional subjective psychology and the sociological systems that are based upon it. However, the behavioristic conception in psychology and sociology is of such recent origin that no attempt has been made to classify the various writers on behaviorism. Hence most of what appears in this

book represents the writer's own interpretations and carries with it all the limitations which this implies.

As to the term behaviorism, I believe most of us who are sympathetic to the conception that it now denotes, realize that it can only represent a temporary condition during which more or less divergent postulates are being formulated into a unified system. During this stage the term behaviorism seems to me about as good as any other. If the behavioristic postulates prove themselves sufficiently important to justify a special name, I am sympathetic to the term "praxiology" suggested by Knight Dunlap.

PART ONE

FUNDAMENTAL PRINCIPLES

THE ULTIMATE ELEMENTS

CHAPTER I

THE ULTIMATE ELEMENTS

Behaviorism is Based on the Assumptions of Physics—Physical Units—The Structure of Matter—Behaviorism and the Structure of Matter—Definition and Demonstration: *Motion, Time, Space, Rate*—The Nature of Energy—Stresses and Strains—Stimulus and Response—The Transformation of Energy—Psychical Energy—The Conservation of Energy—The Concept of Force—Psychical Force—Human Behavior a Form of Motion.

Behaviorism is Based on the Assumptions of Physics

When the behaviorist tries to determine just what phenomena are to be his subject matter, he faces the problem of clearly designating the fundamental conceptions that form the *antecedents* of his own science. Thus, for all ordinary purposes a stimulus defined as a series of light waves or sound waves, as pressure, movement, vapor, etc., seems a clear enough characterization to avoid misunderstanding or error. But if we ask what is a light wave or sound wave in terms of human behavior, we are faced with the necessity of adopting some theory of cosmic development which meets the subsequent *explanatory* phases of the behaviorist's problem.

That human endeavor is made up of movements no one will deny however inadequate such a statement may seem. When the attempt is made to establish what the term movement shall signify in the study of human behavior,—physics, chemistry, mathematics, are obviously the sciences to be consulted. Since we are concerned primarily with movement in the physical sense, chemistry may be regarded as molecular or atomic physics, while mathematics furnishes the conceptions through which the static and dynamic relationships between movements are recorded and described by a symbolism which represents the maximum perfection in linguistic generalization and accuracy.[1]

When we try to understand the physical principles involved in bodily movement, we find a regressing series of assumptions all converging on what the philosophers have called the ultimate or first principles. The assumptions that are adopted as to the nature of these ultimates, determine where the behaviorist will place man as a physical phenomenon, and determine to some extent the nature of the cate-

[1] The conception of mathematics as an ideal language should be credited to Professor Leonard Bloomfield of Ohio State University. The writer, and this seems to have been the experience of others, has never been able to "place" mathematics satisfactorily among the sciences on account of the absence of any subject-matter. However, when mathematics is regarded from the linguistic point of view represented by Dr. Bloomfield, its function (as a recording and defining mechanism which is practically unlimited by the quantitative or qualitative restrictions of ordinary language) in science immediately becomes apparent.

gories by which human behavior is to be described. To describe human behavior in physical terms requires an agreement as to what facts are included under energy, motion, and the structure of matter. That the physicists themselves are constantly modifying their own theories, makes it necessary for the behaviorist to formulate his own fundamental principles on a provisional basis, but this is true of all science. The behaviorist must select some point of view from among the number of possibilities, supplementing and modifying these to meet his own particular requirements. It may happen, of course, that new developments in the fundamental sciences will prove the inadequacy of a given set of assumptions, but this cannot be avoided. It is only confusing when no attempt at all is made to clearly outline the basic principles upon which a given discussion rests.

The writer has selected those physical conceptions which seem to him most helpful in defining what he understands by the phrase, *a human response.* In adopting the physical point of view of the ultimate structural units, it will be necessary to introduce modifications which seem to rest upon the physicists' lack of an understanding of some of the principles underlying human behavior. It would be simpler, of course, to follow tradition and refuse to attempt any ultimate analysis. This is possible as long as

behavior is regarded from merely the systematic or descriptive aspect, but as soon as the study turns to *causes*, we enter upon a regressing series of antecedents which overstep the arbitrarily imposed limits of the various sciences and reach back to what we have called the ultimate or first principles.

Physical Units

Physicists are fairly well agreed that negative and positive electrical particles, described as electrons and protons by McLennon ('22) and Lemon ('23) are the hypothetical ultimate elements out of which everything is built up.[2]

The properties of electrons and protons are those described in the text books of physics under negative and positive electricity. It is immaterial for our present purpose whether these electrical properties are stresses or strains residing on the surface of some more fundamental core that exhibits inertia even when all the electrical forces are stripped off, or

2 In adopting the electron-proton hypothesis as his fundamental assumption, the writer is merely following the scientific practice of leaving the problems of other fields to the experts in those fields. The physicists have constructed a series of regressing antecedent causes which at present reduce to the electron-proton conception. Of course this will no more be the ultimate analysis than the atom of recent chemistry. Even now the mathematicians are working on conceptions that are stirring up the electron-proton type of metaphysics. This need not disturb the behaviorist. If the mathematicians can construct the universe as we now have it, out of merely an assortment of whirling spaces, well and good,—if it runs itself. A physicist turned poet should not expect the type of recognition for his poetry that is accorded him for his physics.

whether the forces themselves, without a core will exhibit the same inertia. It suffices that the motions of these electrons and protons conform to the laws attributed to them. These are: that electrons move toward protons and away from other electrons; protons move toward electrons and away from other protons. This fact is usually formulated into the statement, that like-signed particles repel each other, unlike-signed particles attract each other and that the magnitude of the attraction or repulsion is some inverse function of the distances between the particles. The terms attraction and repulsion are not to be taken in any but a descriptive sense.

The Structure of Matter

If the preceding conception as to properties of electrons and protons is applied to hypothetical aggregates of them, the following three possibilities are presented:

A. Given an unlimited aggregate of like-signed particles only, these would move farther and farther from each other until each particle would be as far as possible from every other particle and the aggregate itself would have a maximum dispersion and a uniform symmetry. Such a condition would not produce the groupings or differentiations known as atoms, molecules, etc., or the phenomenon which we shall finally describe as a human response.

B. Given an unlimited aggregate of unlike-signed particles (assuming the number of possible unlike signs to be as large as the number of particles), all the particles would move toward each other and produce a condition of maximum density and uniform symmetry. This too is a condition which would not yield specific groupings and differentiations such as those which are found in organic tissues. What the actual conditions would be, we have no means of determining, since the unlike signs in our actual universe are limited to only *one* degree of unlikeness (negative-positive) instead of the unlimited degrees of unlikeness we have postulated. It does not seem probable that the conditions described under either (A) or (B) would yield the phenomena known as human behavior.

C. Given, on the other hand, an aggregate of particles, having only one degree of unlikeness (positive-negative) and two degrees of likeness (negative-negative), (positive-positive), limits to both dispersion and density are established. One limit is set as to the nearness with which unlike-signed particles may approach each other until repelled by like-signed particles, and another limit is set as to the distance to which the like-signed particles will move away from each other, until attracted by the unlike-signed particles. Such an aggregate would be continually changing, particularly, if as seems to be

he case, the mass of the proton is about eighteen ıundred times that of the electron. The electrons ınd protons would arrange themselves into groups ›f different types of interlocking symmetries which n time would break up and form new configura- ions. Even if at some "first moment" all particles ıad a uniform spatial and symmetrical relation to ach other, there is no evidence from mathematical heory which would seem to support the assumption, hat there is a type of symmetry which would leave ıll particles in stable equilibrium and motionless. [f then the positions of the particles are unstable (are moving) an unlimited number of geometrical onfigurations or patterns may be formed.

An aggregate of this kind (which is actually the ›ne postulated by physics for the universe) will ʼield the multiplicity of conditions actually observed. Гhe basis of the qualitative distinction between what ve know as different objects is then a function of he geometrical form, or the patterns of symmetry, n which electron-proton aggregates are grouped. All substances that are alike have the same geomet- ical electron-proton arrangement. On the other ıand substances differ from each other in their chem- cal and physical properties, to the extent that there ıre differences in the spatial patterns and the dynamic ›rbits of the several electron-proton aggregates.

The structure of matter is thus a function of its electron-proton configuration. Similar structures have similar spatial and dynamic configurations, dissimilar structures have dissimilar configurations; though the degree of similarity or dissimilarity need not itself be a simple function of any mathematical or geometrical number system now known.

Behaviorism and the Structure of Matter

Assuming as ultimate or fundamental some form of aggregate similar to the type (C) just described, the behaviorist may proceed to develop the particular assumptions best calculated to explain the conditions which produce the human response. For purposes of description, each separate geometrical electron-proton pattern, no matter how simple or complex it may be, is to be regarded as a system. Such systems may be classified into the degrees of similarity or dissimilarity postulated of atoms, molecules, elements, compounds, tissues, plants, animals, men, races, nations, planets, etc. The systems of especial interest to the behaviorist are classified under animal tissues and social organizations.

Definition and Demonstration

All definitions are self-limiting and based on other definitions. The fundamental assumption of all science presupposes that individuals are able to under-

stand each other, and that the limited range of definition may be supplemented by demonstration. Such fundamental conceptions as movement, space, time, are best presented as a demonstration even though this may be a purely verbal performance.

Motion.—In developing a definition of motion or movement we may proceed as follows: A demonstrator *A* points to an object on the table and arbitrarily declares to another individual *B* that this object (as it lies motionless) is in zero motion. *A* moves it toward the right and then defines this act as a *movement toward the right.* *A* then demonstrates movement toward the left, forward, back, etc. With ever increasing complexity *A* demonstrates movements that are long, short, up, down, regular, irregular, circular, elliptic, parabolic, sinusoidal, centrifugal, etc. All of this can be demonstrated without recourse to definition, or rather the definitions can be created *de novo* as new forms of behavior from the demonstration. *A* may now ask *B* to repeat the demonstration to another individual *C*; *C* then demonstrates to *D*, etc. The adequacy of the method as to uniformity is attested when successive individuals in turn take the place of demonstrator and the last individual repeats the demonstration to *A* exactly as *A* originally presented it to *B*. To the extent that the demonstration has gained or lost during transfer from one individual to another,

has it been faulty, and to that extent is there what is known as a lack of understanding. Assuming that the above demonstration has been made and repeated until all the individuals involved respond similarly when asked to demonstrate sinusoidal movements, pendular movements, fast movements, etc., we can then by extension of the principle arrive at a definition of movement which gives it the properties of *rate* and *direction.*

Time.—In defining what we are to mean by *time* it is only necessary to more extensively differentiate fast and slow movement, which we shall assume has (through demonstration) been differentiated into slow, fast, sooner, later, etc. From this we develop the "second" or physical time unit. When all the individuals are able to repeat the "time" demonstration without error, the various persons are said to understand each other or *"to understand what time is."*

Space.—Continuing with the behavioristic demonstration technique, the concept of space can be developed out of the demonstrations or reactions of right, left, up, down, forward, back, near, far, and gradually complicated into systems of co-ordinates and loci which result in the physical units of the centimeter, square centimeter, cubic centimeter, etc.

Rate.—The conception of rate may then be demonstrated as a particular relationship between space

and time, and the conceptions of velocity, acceleration, etc., built up.[3]

The Nature of Energy

The physicist has not placed a theoretical limit on the closeness with which unlike-signed particles may approach each other, or a limit beyond which like-signed particles will not move away from each other. Hence a change in the motions of the particles in any system will be followed by changes in all other systems. These *changes* have been given the name of *energy*, and are of two types: (a) where the change involved modifies only the *scale* or the *ratios* of the co-ordinates by which the symmetry of the dynamic structure of the system is represented, and which is usually referred to as an increase or decrease in potential energy; (b) where the geometrical *form* of the symmetry is altered to the extent that the new co-ordinates are represented by a different type of equation in which instance we speak of a *transformation* of energy. We shall try to make this clearer in the sections which follow.

3 For the behaviorist the ''time-space'' problem loses much of its mystery when it is regarded as a form of behavior rather than a ''unique'' something. When we recognize that science is only a special form of human behavior the question, ''Is time and space independent of human beings?'' merely reduces itself to the absurdity, ''Can special forms of human behavior occur without human beings?'' The universe would have no *geodesic* in it were there no individuals who had acquired those responses that are classified as spherical geometry.

Stresses and Strains

The relationships between the rates and directions of motions within and without the electron-proton systems are measured indirectly through precision instruments. The absence of motion does not indicate an absence of energy. A particle (p) may remain at virtual rest for two reasons: (a) when all other unlike-signed particles are assumed to be so far away that their attraction may be neglected, or all other like-signed particles are so far away that their repulsion may be neglected; (b) when the adjacent like-and unlike-signed particles are so grouped that the attraction and repulsion on (p) cancel each other in all directions. The particle (p) even though at rest under conditions (b) may be said to be under a stress or strain (or have potential energy) because any displacement of any of the adjacent particles will result in a movement of (p). Under conditions (a) the particle is not under stress (or has no potential energy) because any change in the position of the nearest particles will have a negligible effect on (p). This, of course, is never realized under actual conditions, and therefore every electron and proton in the known universe may be said to be under a stress or strain, and all absence of motion results only from the condition described under (b) and can only be relative with respect to some point of reference. It is in this sense that energy is said

to be universal. Because of this universal presence of the conditions called energy every change of motion in any system may be regarded as a *function*, in the mathematical sense, of all the other changes that occur, and that they bear a definite quantitative relation to each other even though the exact relationship or the number system which best describes the relationship, is unknown.

Stimulus and Response

For the behaviorist this functional relationship between movements explains the relation between the external stimulating conditions and the nervous excitations started in the sense organs. The stimulus is to be regarded as one form of stress in the environment. The sense organs are also systems of stresses. The interaction between these two kinds of stresses (light waves and the chemical changes in the sense organs for instance) are the antecedents of a third type of change known as a nervous process. Finally, a fourth type of change occurs, the contraction of a series of muscle fibers, which produce movements of the body or parts of the body. These movements in turn may bring about changes in the environment such as sound waves and speech sounds, which in turn may act as stimuli for the sense organs of other persons and release a similar cycle, *ad infinitum*. The distinction between stimulus, sense

organ, nervous process, muscle contraction, is purely arbitrary. The energy interchanges and the successive equilibria that are established form a continuous series in the cosmic movement continuum[4] whose origin is lost in the past and which will continue into the future forever, so far as we know. The fact that the stimulus usually originates outside of the organism while the response occurs within it, has obscured the continuous character of the energy interchanges. The tendency has been to regard the stimulus as originating *de novo*, and the response as terminating the energy expenditure. If it is recognized that the stimulus has a regressing series of antecedents, and that the response has a series of subsequent effects, it will be easier to understand that both stimulus and response are merely episodes, as it were, in the constant flux of energy transformations in the universe and that the bodily phase is merely an acceleration or deceleration of the sensorimotor metabolic rate, of a given locus (the individual) in the movement continuum of electron-proton changes.

The Transformation of Energy

The electron-proton movements may be grouped into various geometrical types. Some movements,

[4] The quantum theory suggests that the movement continuum is actually atomic in structure. This affects the present argument only in the sense that the energy interchanges are atomic in character rather than continuous.

as those occurring in a luminous body, are transmitted enormous distances and at a rapid rate, as in light, magnetic, and electrical waves. Others are primarily surface effects, such as pressure; or dispersion, as in vapors and gases; or intermolecular changes, as in heat; vibratory motions in air particles, as in sound waves, etc. These forms of energy are to some extent convertible into each other, as light into heat, magnetism into electricity, etc. When water changes into steam on boiling, the general environmental conditions surrounding the water molecules are such that the electrons and protons in the liquid molecule change their positions with respect to each other and take up the position which they possess in the vapor molecule. It is this *change* from one pattern or system of symmetry to another that has been named the *transformation of energy*. Just as the properties of a substance are a function of the dynamic and spatial arrangements of limited groups of electrons and protons, so the various energy transformations are functions of the *movement* types by which one type of electron-proton symmetry changes into another until a new symmetry has been established. Matter may thus be regarded as a relatively stable electron-proton symmetry and energy as the *change* from one type of symmetry to another.

Psychical Energy

The behaviorist recognizes that there are many facts in physics still to be discovered and that the physics of the electron and proton have scarcely been touched. But, to use this as an argument in favor of the existence of non-material (spiritual or psychic) forces, or to imply that inability to reduce even the simplest protoplasmic systems into their electron-proton components demonstrates the existence of non-mechanical forces, does not seem justified when we consider the trend of scientific development.

Before the microscope was invented, the human soul was described as a vaporous sort of material, too tenuous to be seen by the eye and which percolated through the bodily tissues. The microscope increased the range of vision, but instead of revealing the expected soul substance, the organic cell as the element of biological function was discovered. The soul substance theory almost vanished, but we still have shades of it with us as psychic or "vital" forces. Just as every advance in science has made the conception of a spontaneous psychic energy less plausible, so further advances are more likely to hasten its disappearance rather than to furnish the evidence that substantiates its existence. In view of this trend the behaviorist does not anticipate the discovery of a form of movement which spontaneously generates itself, though he is perfectly willing

to concede the existence of physical energy transformations that have not yet been observed.

The Conservation of Energy

If a particle (p) should be displaced one inch in a straight line, the movements of all other particles in the universe would be changed with respect to rate, magnitude and direction, depending on the potential energies of the systems to which they belong. If it were possible to prevent these changes, the particle (p) would snap back one inch into its original position. A quantitative equivalence is said to exist between the straight line movement of (p) and the many forms of movement that would have occurred in the other particles had they been permitted to establish a new equilibrium. This type of relationship the physicists call the conservation of energy. It is merely a statement to the effect that if the present instant is regarded as an inflection point between the past and the future, the dimensions of the electron-proton movements of the past are equal to the dimensions of the electron-proton movements of the future when reduced to a uniform basis such as linear dimensions.

When a weak stimulus releases a strong response, the stimulus supplies merely the amount of energy which represents the difference between a system just ready to change and one which has already changed;

e. g., the energy stresses within the glucose molecule, changing to the contractile energy of the muscle fibers. The stimulus merely acts as the trigger to release potential movements that have been elaborated during the previous metabolic activities of the organism. In order to approach the mechanical equivalence postulated in the conception of the conservation of energy, a much greater temporal and spatial range must be considered in the explanation of human behavior than it is customary to consider in the various heat and mechanical cycles by which the physicist demonstrates the conservation of energy. In this connection the modern development of physical theory under the "principle of least action" seems to support the behavioristic conceptions of the writer, although it is still too early to do more than indicate that the principle does not seem to be contradictory.

The Concept of Force

The term force has resulted in much confusion even among physicists. This confusion is largely due to the linguistic habit of assigning a special name to relationships which are biosocially significant and then assigning the *name* as the *cause* of the relationship. Thus, practically considered, it is found that the damage caused by a falling body depends on the weight of the body and the distance through which

it falls. A small body falling from a great height may cause the same damage as a large body falling a short distance. This is an important relationship between mass and velocity and in order to remember this relationship the *product* of the mass and the velocity of a body was given the name of *momentum.* As soon as the name was assigned it lost its significance as a name for a *relationship* and became the name for a new entity. The damage caused by falling bodies was now held to be due to their *momentum,* and bodies were said to contain varying amounts of momentum (or force) which was *generated* while the body was in motion. Even now such terms as gravity and inertia are often regarded as *properties* of bodies instead of merely names for relationships. The expression that the body falls to the ground because of gravity is quite common and for those who use it, the expression seems to imply more than the fact that the body falls to the ground because of the presence of the earth. So insidiously does this fallacy creep into even the most critical physical theory that such terms as energy and force are described as attributes or properties or even separate entities rather than merely as the names of observable relationships between the stimulating conditions which release human behavior of one type or another.

For the physicist the term force or energy designates a *relationship* between certain types of movements, not a property of substances. In the quantitative representation of these relationships a technique known as the parallelogram of forces has been developed, which makes it possible to calculate the resultant dynamic condition of a given body in relation to other bodies. Much of the opposition against the mechanical conception of human achievement centers in the fact that in the measurement and analysis of human behavior it is not yet possible to apply concretely the parallelogram of forces technique.

From the behavior standpoint the organism at any moment may be represented as a diagram of potential and kinetic forces, in the sense that all the movements within it and around it (both molar and molecular) represent changes in equilibria among the systems of which the organism and its environment are made up. This is, of course, exactly what is occurring throughout the whole universe; and the behaviorist maintains that no further assumption is required to account for even such a complex system of symmetries as that represented by the League of Nations.

Psychical Force

The fact that force is the name for a *relationship* between stimuli and not a stimulus itself is also a source of error in the traditional conceptions of hu-

nan behavior. The individual is supposed to not nly possess physical and chemical properties but also property known as psychical force. If the psy-hical force were merely regarded as a relationship etween, say such things as the rate of solving a roblem and the adequacy of the solution as meas-red by certain biosocial standards, no confusion vould result. However, the psychical force is re-garded as some property of the organism which *roduces* the adequate solution. If a physical force s the name for a particular relation between physical nits, then a psychical force should be the name for particular relation between psychical units. Con-retely, if "volition" is regarded as psychical force, t should be a particular relationship between such sychical units or elements as sensation, image, feel-ng, *Gestalten*, or whatever may be regarded as the sychical elements of a given psychological system. However, there are no relationships between sensa-ions, images, feelings, that are so uniform and con-stant that anyone has attempted to formulate them nto an equation. If, for instance, we could say hat a given visual sensation is invariably followed y a given visual image there would be a justifica-ion for a term such as psychical force or mental orce; but such a relationship between sensation and mage or any of the so-called mental elements has never been affirmed. If, as is the case, it is neces-

sary to introduce a physical or physiological series upon which to base whatever uniformity may be found in the so-called psychical relationships, then we are actually dealing with physical forces and the term psychical force does not represent a non-physical force but only a special type of relationship between physiological processes.[5]

Human Behavior a Form of Motion

It is possible to think of all the motions or movements both animate and inanimate that are occurring on the earth and in the universe as an aggregate of movements all causally related to each other, to past movements, and as the antecedents of the movements that will occur in the future. To simplify the problem of scientific investigation, these movements have been grouped into a number of classes such as: submicroscopic, microscopic, molar, geophysical, and astronomic; into animate and inanimate, roughly corresponding to the sciences of physics and biology taken in the widest sense. The animate movements of biology are again divided into plant and animal movements and form part of the subject matter of botany and zoology. The movements in zoology are divided into animal movements and human movements. Human movements form

5 The writer is not particularly dominated by the law of parsimony, but unless an unnecessary assumption has some esthetic or personal value to commend it, why go out of our way to find one?

the subject matter of a number of sciences,—anatomy, neurology, physiology, psychology, anthropology, linguistics, sociology, ethnology, economics, ethics, medicine, etc.

The study of human behavior is concerned particularly with those movements made by man, which establish the social status of the individual in some ethnic or social group. These movements are called human behavior to distinguish them from those movements which form the subject matter of the other zoological sciences. All movements in the universe, that have occurred in the past, that are occurring now or that will occur in the future, may be regarded as belonging to a closed system of interacting forces, and the movements of mankind may be regarded as a part of this interrelated system of movements. The interrelationships are more obvious when they are temporally and spatially adjacent, but every movement that occurs, even the movements by which this particular *word* is written, must be regarded as causally conditioned by every movement that has occurred in the past and all the movements that occurred at the instant the word was written. Of course, only a few of the components can actually be demonstrated and for the purpose of establishing certain social categories most of the remoter causes may be regarded as having a negligible effect.

The degree of physical isolation which has existed and still exists between various groups of mankind, has developed classes of movements that are more or less closely related to the concurrent physical and social conditions, and these classes of movements have been given the name of tribal, racial, national activities. Each of these classes has passed through a series of phylogenetic developments in addition to whatever ontogenetic changes may occur. The degree of uniformity in these movements (the behavior) is sufficient to justify the classification of the total behavior of the individual from two points of view: (a) As an ontogenetic series representing the influences of inheritance and training, (b) as a biosocial series representing the influence of training and environment, both contributing to the maintenance of the social organization of which the individual is a member. Thus, in the last analysis human behavior is reduced to movements between electron-proton systems, but this reduction is the final aim of all scientific investigation. As an expedient in social co-operation the behaviorist specializes in the study of those complex forms of motion which, for want of a better classification, are designated as the educational, vocational, administrative, recreational, and personal activities of the individual.

MAN AND THE UNIVERSE

CHAPTER II

MAN AND THE UNIVERSE

Behaviorism and Metaphysics—Behaviorism and Physics—Motion and Organization—The Movement Continuum—Behavioristic Solipsism—Man an Episode in Cosmic Evolution—Cosmic Evolution an Episode in Man—Physical versus Psychical Monism—Psychical Laws—Psychical Causation Unnecessary.

Behaviorism and Metaphysics

I do not agree with those psychologists who protest against the introduction of *any* theory of reality into psychology. As long as psychologists refuse to take a stand on some theory of reality, any attempt to reach an agreement as to the causes of human behavior must be futile. The present lack of agreement is largely due to the fact that as soon as a discussion approaches the fundamental assumptions upon which the controversy rests, the real issue is avoided by a hopeless,—"but this is approaching the field of metaphysics with which psychology has no concern." After all, there is very little real controversy as to what is observed; the difficulties arise when the observations are to be analyzed or classified. To refuse to classify them on some fundamental basis, and this is what this

attitude means, simply blocks scientific development.

It seems to me that the reprimand implied in the frequently used expression, *a purely metaphysical conception*, has restrained scientific speculation and development unnecessarily. Certainly the behaviorist can no longer remain intimidated. Metaphysics, for the behaviorist, is merely a form of behavior which familiarly is known as "guessing" and which technically consists in developing a verbal description of what probably would be observed if more refined experimentation or observation were possible.

One of the problems of science is that of determining the antecedent conditions which precede the appearance of some experimental or technical result. Next the antecedents of the antecedents are isolated, and so the investigations are continued backward until a stage is reached beyond which experimental analysis or observation has not gone. To the extent that the scientist tries to anticipate what those antecedents are, which have not yet been experimentally established, he is a metaphysician. He may be unfamiliar with the special terminology developed by the professional metaphysician but the scientist's methodology (mathematics) seems to have decided advantages over that of formal metaphysics. The usefulness of any guess as to the nature of unobserved antecedents depends upon how well the

guess is verified when the experimental technique will have been refined to the point at which a testing of the validity of the guess or prediction is possible. Thus, until recently by following this method, the chemist regarded the atom, of which he postulated about ninety different kinds, as the ultimate unit or element in the structure of matter. As experimentation became more refined, the guess of ninety different kinds of elements was not verified. A new guess was proposed by the physicists,—the electron-proton hypothesis, in which the number of units was reduced to two. For the physicist, then, the electron-proton hypothesis is a guess as to what would be observed visually with a microscope of sufficient magnifying power. On the whole it is to be expected that the physicist who *uses* the microscope, *performs* the laboratory analysis and then *reports* the results, should be better qualified to guess the nature of the antecedents of what he observes, than the professional metaphysician who has available only the verbal report of the physicist.

The metaphysical problem as it presents itself for behavioristic analysis, can only be a study of the biosocial antecedents of the language responses (metaphysical discussions) recorded in the literature as the verbo-motor responses of individuals who, for the time being, are classified as metaphysicians. The *scientific* solution is thus narrowed down to an

investigation of the metaphysician's heredity and training. All metaphysical discussions, no matter how profound and involved they may be, are in the *last* analysis nothing but language responses and linguistic habits derived from other language responses. In science, observation and the analysis of experiential conditions play a much larger part. When the metaphysical problem is stated in the form of the question, What are the essentials of reality? the term *reality* for the behaviorist is merely a word stimulus which individuals of a given social status use to designate the fact that the responses occurring at any one moment might be more complex and varied than they actually are if the bodily response mechanism were more complex than it really is.

Thus I may affirm that the clock in my room has an existence or reality aside from my reactions to it because of the following behavior conditions. Suppose one of my responses is that of counting the ticks. The number of ticks that can be counted seems to be unlimited, but the manner of counting may be continuous or intermittent. The alternative responses of counting or not counting are not determined by the nature of the clock stimulus. That is, if I had installed an automatic counter for the ticks, the visual readings of this counter would be correlative with *continuous* auditory counting, but not with

intermittent auditory counting. In terms of behavior this only means that some responses (oral counting) and other responses (visual counting) are sometimes correlated, sometimes not, and that the cause of this correlation is some condition (clock) that is independent of my own body.

Reality is merely the term that designates this type of relationship between responses. It is the basis of the fiction of an external world of stimuli. This particular fiction, as a form of behavior, has persisted. Another fiction, characterized as solipsism, has never been generally adopted even though my own responses are the only responses that ever occur. Certainly I have never found myself doing anything else. When I am not reacting (as in dreamless sleep) there is only oblivion. For the behaviorist, then, the problem of the nature of reality is a biosocial problem of tracing out the type of behavior which corresponds to the assumption that there is an external reality of which man is only a part and that this assumption has survived longer (produced better co-operation between individuals) than any other.

The specific training of a metaphysician is such that he, more than other persons, is disposed to ask such questions as, What kind of a life will I lead after I die? But by the act of formulating such a question he does *not* demonstrate the existence of

an "immortality" stimulus, or prove that an investigation directed toward establishing the nature of life after death is a scientific problem. The biological condition that is responsible for the metaphysical problem may be nothing more than the fact that the biosocial and neuro-muscular antecedents of the *verbal* response, What kind of a life will I lead after I die? can now no longer be separately discriminated and localized. It is a fact that there are no known receptors which release discriminative responses to the changes which have taken place or are taking place within the central nervous system. When science will have developed a technique by which *all* of the biosocial and biophysical factors operative in the origin and development of our language responses can be made scientifically accessible, the problem of metaphysics will disappear. In other words, for the behaviorist the metaphysical problem is merely that of trying to understand the conditions under which the language habits of the metaphysician have been acquired.

Of course the electrons and protons are metaphysical constructions which belong to the same category as "the thing-in-itself," "neutral stuff," "elan vital," "psychical force," but when we are faced with the problem of adopting a fundamental assumption toward which the analysis of human behavior might regress, the physicist's electron-proton

ultimate reality has the advantage, (1) that it can be stated in the most effective language responses (mathematics) that have been developed, and (2) that it can be synthesized into atoms, molecules, protoplasm, animals, man, social organization. On the other hand, the *ultimate realities* of the professional metaphysicians seem incapable of synthesis into anything more unified than is implied by the term *uniqueness*, which can neither be demonstrated nor defined. This is the reason why I adopted the electron-proton type of metaphysics as best adapted for the study of human behavior.

Behaviorism and Physics

One of the important relationships in physics is that which exists between mass and acceleration. In fact so useful has the observation of this relationship become, that the product of mass and acceleration has been given a special name, that of "force," and the technique of using the equation is acquired by all physicists. However, for the physicist, his own behavior and that of others does not constitute a problem in physics in the sense that he tries to reduce his own responses to a parallelogram of forces of the type found in his own text-books. But suppose the physicist were to ask, How did this equation get into the text-books? He would then be formulating a typical problem for the behaviorist, not an easy

one to be sure. If the physicist (as a behaviorist) undertook to investigate this problem (how the equation got into the text-books) he would not expect the equations in the physics text-books to have the same relative importance when he investigates his own behavior, as when he demonstrates the subject matter of physics, even though he may (as the behaviorist does) regard his own behavior as physical. Therefore, even though the behaviorist adopts the fundamental conceptions of physics, he must develop, so to speak, special physical equations (individual and social measurements) which meet his special requirements.

Regarding the universe (which of course includes man and his work) as a physical continuum composed of nothing but electron-proton aggregates and the movements that take place among them, the physical sciences investigate these aggregates and classify them into the categories of mass, length, time, acceleration; electric, magnetic and mechanical energy; and the many other relationships characteristic of physics, chemistry, and physiology.

The principle according to which these classifications are developed is directly or indirectly based upon the principle of the conservation of energy (or motion). But the properties of the electron-proton aggregates may be classified in other ways, even into categories in which the conservation of energy is

relatively unimportant. Human behavior is such a group of categories. This does not imply that human behavior is not physical or that it does not conform to the law of the conservation of energy. It does mean, however, that the conception of physical measurement as a branch of the science of mechanics should be expanded to include that type of individual and social measurements which are now classified under so-called *mental* measurements; that the equations in centimeter-gram-second units by which we now express the causal relationships between electron-proton aggregates, should be modified to include such *behavior* equivalences such as spelling activity, obedience, going to church, war, or generally speaking, the individual-social activities which establish the individual's status in the social organization. In other words, the behavior of the physicist is just as physical as the physics he teaches.

Motion and Organization

When human behavior is studied as a form of motion[1] differing only in complexity from the motions and dynamics of physics and mechanics, behaviorism assumes the systematic status of physical monism, of which electrons and protons have been accepted as the ultimate elements. On the assump-

[1] This conception of the nature of human behavior is directly opposed to the purposive and teleological character of behavior as presented by McDougall ('16).

tion of the validity of the law of the conservation of energy, every electron-proton change that occurs results in the redistribution of the stresses or strains that are present in every other electron-proton aggregate, including, of course, the particular aggregate known as the physicist or the behaviorist.[2]

Beginning then with the fundamental assumption of physical monism in which the ultimate and sole elements are electrons and protons, we may establish the following series based upon complexity in organization:

Electrons and protons form atoms ranging in complexity from the neutral hydrogen atom made up of one electron and one proton, through over two hundred distinct atomic types of symmetry (including the isotopes) to the complex and unstable electron-proton structure of the radium atom. Atoms form molecular organizations again ranging in complexity from the neutral hydrogen molecule made up of two electrons and two protons, through an unlimited

[2] This extends the traditional conception of cause and effect to the general statement that *everything which precedes, causes everything that follows.* The causal relationships postulated by the various sciences are merely convenient biosocial classifications according to which some antecedent conditions are more important than others, while the effects of other antecedents may be neglected entirely. The chemist may regard the Odyssey of Homer as having a negligible causal effect upon the particular chemical reaction that he may be studying at a given moment; while the linguist may regard the effect of the glacial period in what is at present North America as having a negligible effect upon the linguistic characteristics of the Odyssey; but these are merely technical expedients.

number of compounds ending up with such complex structures as the albumins, forming a relatively stable organization made up of thousands of atoms. Molecules form systems of chemical compounds, the most complex of which are the protoplasms. Protoplasmic complexes form groupings beginning with the filter-passing bacteria and ending with the complex cell structure of the unicellular organisms. From the differentiation and grouping of cells are derived organs, tissues, and structures which form the multicellular systems that found their largest representatives in the prehistoric herbivora. In man the multicellular type of organization is being augmented by what we may characterize as a *compound multicellular* form of organization,—the group, tribe, state, nation, and representing the highest degree of complexity in electron-proton organization so far as we know.

The human response is a unified group of contractile effects through which the compound-multicellular organization (social organization) becomes, shall we say, more complex, more stable, and larger? We do not know. It is part of the behaviorist's problem to find out.

In adopting physical monism any conscious or psychical entity as distinct from the physical electron-proton entity is, of course, excluded. The formulation of the behavioristic position is then expressed

in the statement that all human conduct and achievement reduces to *nothing but:* (a) different kinds of electron-proton groupings characterized according to symmetry or geometrical structure; (b) the motions that occur when one structural or dynamic form changes into another. In other words, I assume that the scientific study of what is generally known as personality and social organization can be conducted under the assumption that the physico-chemical continuum is the sole existential datum and that the totality of the electron-proton aggregates *is* the universe in which we live. Of course, I do not imply that human achievement can *now* be reduced to an electron-proton formulation. Neither is this possible in physics itself. My statement merely implies that I am opposed to the general attitude that until the last event or occurrence (especially those known as human achievement) has been reduced to a mechanical resultant, we must assume the existence of a non-physical (psychical) entity. It seems to me scientifically more expedient to follow the physicists who have (as physicists) inverted the principle and refuse to accept a non-physical entity until all mechanical conceptions have proved futile.

The Movement Continuum

When the behaviorist begins to assemble the facts to be included under the term behavior, on the as-

sumption that the universe is the totality of the electron-proton aggregates and the changes that occur in their spatial relationship,[3] he begins his analysis in the following concrete manner. Regarding an infant as an electron-proton aggregate, he observes that the child's visual and auditory sense organs are being exposed to practically the same electron-proton conditions as his own and the other adults around it. Yet its responses are entirely different. If, for instance, the nurse responds to the position of the hands of the clock by preparing the infant's bath, the infant, if it responds to the clock at all, may do so by cooing, crying, the listening posture, etc. Unless the infant does react to the clock in some specific manner there is no way to determine whether that electron-proton aggregate known (to the behaviorist) as a clock, is modifying that aggregate known as the infant. Further (for the behaviorist), both clock and infant are only specific movement effects in his own body. That is, according to the electron-proton hypothesis, clock, infant, writer, reader, time, space, electrons, or protons, are all forms of motion and in the absence of any motion these things would not exist. Of course there is nothing remarkable

[3] On this assumption the traditional *mind-body* problem is converted into the *mind-motion* problem for those who recognize this relationship as a problem. It seems to me that an attempt to determine the relation between mind and motion soon demonstrates the futility and contentless character of the attempt.

about this. The term existence is only a synonym for movement, and when it is said that without motion the universe would not exist we are only stating the tautology that, "if there is no motion,—there is no motion."

The *individual* on the basis of physical monism, is to be regarded as a locus in this movement continuum, and a function (in the mathematical sense) of the changes that are occurring in all other electron-proton aggregates. A human movement as a cross-section of this locus at a given time, is the *effect* of antecedent changes, and the *cause* of subsequent changes. Some of the movement combinations are classified as human behavior and for these some of the antecedent changes are classed as stimuli. The movement combination which is the locus of orientation is the response, if it precedes changes in other loci (individuals). The term response is relative, depending on whether the movements are to be regarded: (*a*) as the effect of antecedent movements, (*b*) as the cause of subsequent movements. Since, however, the locus of the *cosmic* movement continuum is in the sensori-motor system of the individual, its properties will depend upon sensori-motor organization, and the properties of the movement continuum can thus only be described as

functions of, or in terms of, human responses.[4] The problem of investigating these properties becomes that of selecting, as standards of comparison, those responses that are:

1. Relatively independent of the personal variations in sensori-motor organization;
2. Easily acquired and made uniform from individual to individual;
3. Serial in character and readily described mathematically and graphically;
4. Released by the sense organs having the greatest sensory range, either unaided or supplemented by precision instruments.

From the responses selected on this basis are developed the fundamental physical categories of space, mass, and time; the c. g. s. (centimeter-gram-second) system of measurements; the fundamental physical categories of light, sound, pressure, motion, vapors, solids, gases; and the physical, chemical, and electro-magnetic properties. For the physical sciences the stimuli represent electron-proton conditions that are considered independent of the sensori-motor or-

[4] I wish at this point to call attention to the fact that I regard the stimulus-response category as a scientific fiction, of the same sort as the object-subject, mind-body fictions. Its advantages, however, lie in the fact that both stimulus and response are variables of the same systematic entity, viz: movement, and that of all possible entities, movement can be measured with the highest possible degree of accuracy and can be represented with a maximum degree of uniformity entirely beyond the range of such entities as are included under the terms mind, consciousness, etc.

ganization of the individual, and the effect of these stimuli on the responses of individuals is given no theoretical consideration. For the behaviorist, however, the sensori-motor component in the development of the physical categories can not be taken as zero, but only approaches a *constant* (in the mathematical sense) as a limit. When the biosocial categories are considered, the sensori-motor component becomes a variable (instead of a constant) having very wide limits. This is the condition when the reaction of one individual becomes the stimulus for another.

When a reaction is classified on the basis of the physical c. g. s. system of units (as a series of muscle twitches) all individuals who have acquired the reactions will respond in a relatively uniform manner. When, however, a reaction is classified on the basis of the personal or social effects it produces in others, these effects will depend on:

1. Variations in the sensori-motor conditions as determined by inheritance and past function;
2. Social conditions and special training;
3. Age and social status;
4. Historical and cultural antecedents of the group, race, nation, etc.

From the responses selected on this basis, are developed the fundamental social categories such as

co-operation, political organization, morality, the influence of history, democracy, religion, etc. For the behaviorist the stimulus is not restricted to the hypothetical non-sensori-motor conditions which precede a reaction, but the reaction itself is regarded as a stimulus which modifies the behavior of other individuals, and the subsequent responses of the individual himself.

Depending on the degree of sensori-motor participation, two distinct types of investigation have developed: (*a*) the physical sciences which establish the properties of the movement continuum as independent of the sensori-motor organization of the individual; (*b*) the social sciences which establish the properties of the movement continuum as dependent on modification in sensori-motor organization.

Behavioristic psychology occupies an intermediate position, on the one hand investigating the effect of physical conditions on sensori-motor functions, and on the other, the effects of sensori-motor function on social organization. Its specific contribution to general science I regard as that of bridging the gap between the physical and the social sciences and explaining social organization and individual achievement in terms of physical and mathematical methodology. Thus there arise two criteria with respect to which human movements may be classified: (*a*)

as neuromuscular effects of *preceding* movements, (*b*) as neuromuscular causes of *subsequent* movements. I have differentiated these two classes by the terms biophysical and biosocial. I shall use the term biophysical for the neuromuscular (muscle-twitch) phase of the human response, and the term biosocial when a reaction is classified with respect to its stimulus character (meaning) either for other individuals or for the same individual at a later time.

At this point it may be well to call attention to the so-called solipsism of all monistic systems.

Behavioristic Solipsism

The solipsism of the behaviorist follows from the assumption that the *individual* is regarded as a locus in the movement continuum. Human behavior is, of course, restricted to bodily movements and no event of an external world can be discriminated until it acts on the sensori-motor mechanism. Solipsism is merely a recognition of the fact that all discrimination is sensori-motor discrimination; there is no other form of movement. These movements may become extremely complex as in speech, and the movements within one locus may develop a particular group of verbal responses such as the electron-proton theory, but these responses can never be more than functions, in the mathematical sense,

of conditions outside of the body. As long as a man's body or at least his effector system is restricted to a spatial locus, the totality of the electron-proton conditions which he postulates, must exceed the limits of his reaction mechanism and his reactions must be partial, or functions of the larger cosmic aggregate, no matter how they may be mediated through sense organs. For the behaviorist solipsism is a term used to designate the fact that the individual never does anything but react. When he does not react,—he does not react. In other words, the individual either moves or he does not move.

Man an Episode in Cosmic Evolution

In the preceding sections I have given a brief outline of the principles that, for me, seem necessary to the study of human behavior as a form of motion. As science develops it seems to become increasingly clear that man differs from other material systems only in complexity. Just as the movements of the sun and of the planets making up the solar system may be regarded as an episode in the general scheme of the universe, so man on earth may be regarded as an episode in the earth's life history. From the hypothetical condition of individually free and independent electrons and protons we pass to more complex electron-proton

groupings: atoms, molecules, protozoa, metazoa, organisms, species, families, tribes, nations. The one fact that confronts the scientist at every turn is that the electron-proton groupings on earth are being formed into larger and larger organizations, of increasingly complex interlocking electron-proton symmetries, and of greater variability in stability. The universe is merely the totality of these electron-proton systems and the organizations which they form.

The behaviorist maintains that man is a function of the universe and this only means that "a man" is an organization of systems (atoms, molecules, and the tissues of the body) relatively permanent, but participating in the general interchange of movements between systems and organizations of systems on exactly the same plane as any other system. Those energy interchanges that are called life processes,— nutrition, reproduction, adjustment, are changes that are mathematically continuous functions involving not only man himself but the environment both adjacent and remote, and extending backward to the beginning of things. The neural, metabolic, and other changes within man's body may exhibit transformations of energy which never occur outside of it. The individual is not a copy but a part of the universe.

Man is one out of many types of electron-proton organizations that exist. The afferent neural processes, the cerebral processes, the motor processes, and the effects of man's movements on the environment and upon other human beings, represent a continuous series of changes occurring between electrons and protons, which do not start or end with man. To illustrate: changes (incandescence) occur in the sun. These are propagated outward as other changes (light waves); the light acts on the rods and cones of the retina and another transformation of energy takes place (neural processes); these are propagated along nerve fibers to the brain and thence to muscles in the speech mechanism and these on contracting produce the air waves, "The sun is hot." These sounds may act on another individual's ears and he moves toward the shade, avoiding a sunstroke. The absence of the sunstroke makes it possible for other stimuli to become effective and release pattern-responses that have been forming in the individual's nervous system for the last ten years. As a result he may write a treatise on heat engines. The printed pages in the book stimulate the eyes of some engineer who designs a new kind of heat engine, which revolutionizes transportation, and the distribution of the natural resources of fuel which now becomes a so-called national necessity. A war is fought involv-

ing millions of individuals. There is no need to continue.

The original change in the sun goes on and on forever. There is neither end nor beginning. The fact that a given locus called John Smith at one time formed part of the series of changes, is a relatively unimportant fact from a cosmic standpoint involving millions of years. In other words, the whole process is continuous and all steps are equally or unequally essential in producing the effect at a given moment. The obscurity of the origin, the remoteness of the end and the convenience of scientific classification make it necessary to arbitrarily designate one stage of this continuous change the stimulus, and the other the response. It is a quite adventitious fact that only that stage of the chain of changes that occurs in my own body is called human behavior, and that this behavior is the only manifestation (or function) of the cosmical changes. From the behaviorist's standpoint every change that took place is preceded by other changes, and in turn is the antecedent of subsequent changes. Man's place in the universe is an episode, characterized by cosmic changes which are somewhat different because he existed but which form a vanishingly small part of the total changes that include the origin and disappearance of planetesimal systems, thousands of times greater than the solar system in

which man has his brief being. Any attempt to make man the center of the universe is merely the fact that in the development of his individual and social organization, it has been possible for his own behavior to become a more correlative function of a greater number and complexity of cosmical changes.

Cosmic Evolution an Episode in Man

It may be urged that the very assumption to establish man as a part of the universe is a construction made by man himself, and that it is much nearer the truth to maintain that the electron-proton universe has really been *created* by man. No objection can be urged against such a conception, since all science, all philosophy, and poetry, are in the last analysis speech and manual reactions occurring in the body of some individual and persisting as historical or contemporaneous records in our scientific and philosophical writings. When, however, we attempt to determine precisely and quantitatively just how man constructs his universe we have not been successful. To start with the assumption that man's psyche or mind is the ultimate reality and that the electrons and protons of the physicist are actually psychical entities (ideas, images, concepts) constructed by man, is certainly the more acceptable hypothesis for the average man and also represents the traditional point of view. However, man in

his scientific as opposed to his poetical or religious activities also asks this question, What is this psyche? To say that the question itself is a psychical manifestation of another sort, is of course, no scientific answer. For the poet the question, What is the psyche? seems to be a simpler question than, What is an electron? That is, if the nature of the psyche as derived from non-scientific writings and the nature of electrons as derived from physical monographs are both presented to the poet, he will probably accept the psychical explanation as the clearer and more acceptable account of the evolution of the universe. Poetry, religion, morality, affection, love, intellect, for the poet will seem to be a matter of sensations, images, feelings, and spirit, rather than electron-proton configurations. The scientist, however, will regard the physical explanation as the better working hypothesis, at least in his own field, although he too may have certain reservations as to the adequacy of physical causation when he considers such activities as morality, religion, art, etc., in which he is on the same level with the poet or non-scientific individual.

The behaviorist, however, is faced with the problem of describing human achievements in the most accurate and uniform of all languages (mathematics). The traditional spirit or psychical conception cannot be thus described. The scientific objection

to regarding the universe or the environment as an episode in man lies in the fact that the significance of man is over-emphasized. The type of behavior developed under environmental conditions in which the universe is regarded as *created* for man or by man, develops socialized behavior based upon the most variable part of the sensori-motor system of the individual. This results in forms of stimuli which are described as teleological and which have limited the co-operative forms of behavior between individuals. In other words making man the center of things makes him provincial; making man a part of the universe, results in greater sensori-motor interchangeability between individuals and in greater variability and complexity of electron-proton organization in conformity with the laws of motion that have been postulated of electrons and protons.

Physical versus Psychical Monism

In trying to formulate the principles which best serve to explain human achievement we find two alternatives: (1) Man considered as a part of the universe of electrons and protons, or (2) The universe considered as a theoretical construction built up out of some non-material psychical equipment possessed by man. The development of (1) has been undertaken in the preceding sections. With respect to (2) the fundamental problem is that of

an analysis of the psyche into elements and psychical combinations on the basis of which man's biophysical and biosocial responses may be regarded as resulting from the interaction of psychical elements. The selection of these elements has been the problem of philosophy for the last three thousand years. The answers have been numerous and varied, but the majority of mankind has adopted, at least as a working hypothesis, the assumption that the environment is more than a construction of psychical entities. When I stumble, my foot has encountered a "real" obstruction which has an existence quite independently of the complex of "stumbling sensations" which I am experiencing. However consistent the principles of psychical monism may be we must recognize the fact that these principles have not been incorporated into our educational methods. Man in his development from the infant to the adult stage is a moving organism, and these movements can be better classified and predicted when regarded as interactions between the organism and an environment (hypothetical as it may be) than when regarded as psychical processes ejected or projected out of the organism itself. To say that the heat which I feel when my finger touches a hot stove is only a psychical percept made up of certain groupings of tactual and temperature sensations occurring in or constituting my mind, which may be arbitrarily dis-

placed by feelings of well-being and happiness, would if used as a basis for adjustment, result in the gradual elimination of the human race. There may have been infants who reacted to the burning candle by introspecting out the sensations rather than by withdrawing the hand, but such infants would not, in the long run, leave many offspring to inherit this mode of adjusting themselves to their environment. Popular psychology has adopted a middle ground. We have an environment that has an existence which is independent of our psychical processes.

Attempts have been made to regard the psychical factor in man as a function of a sort of universal psychical reservoir, but of course this merely pushes an investigation of the nature of the psyche into a region where analysis is impossible. To say that man has created the universe in his own image or that it was created in conformity to some other image or plan by a superman may be adopted as a working hypothesis, but the opposite of this hypothesis, that the universe has created man in its own image (man is a function of the universe) is the working hypothesis of science. The principles underlying modern science are based upon the evolutionary conception. In the science of biology, the principles of ontogeny and phylogeny have practically displaced the teleology upon which a pure psychical system

is based. From the practical side, those individuals whose behavior is of the most co-operative type, survive longer than do individuals who react as if the external world were merely a group of perceptions to be manipulated through shifts of attention, imagery, etc., and not through co-operation with other individuals.

It is not, of course, necessary that an individual be able to formulate explicitly either the physical or the psychical conceptions here indicated. This is itself an action which represents a very late stage in the verbal response acquisition of the organism, developed long after the direct mechanistic responses to the environment have been established. We are objective scientists by inheritance and the exigencies of survival. After the mechanistic mode of reacting to the environment has been established, the organism may verbally adopt any one of the many psychical systems in which the environment is held to be a series of mental states. The belief in Christian Science does just this when it regards disease as an ideational idiosyncracy. As long as such a theory is not applied too rigorously and is limited to ailments largely illusions to begin with, it need not seriously interfere with the social status of the individual, but if it is assumed that a psychical lunch will furnish the same number of calories as a physical lunch it soon becomes necessary to modify the

heory. It is possible to *explain* physical processes s particular groupings of so-called psychical elenents, but as a working hypothesis it leads to the xtinction, either social or organic, of the individuals vho *apply* it.

Psychical Laws

When an attempt is actually made to formulate he laws according to which the psyche functions, r according to which the individual creates his uni'erse, it has been found necessary to postulate some ort of an entity or existential datum (a sensoryerebro-motor system) outside the psychical system. n other words "pure mind" or "pure psychical proess" without something physical to work on has not een formulated into a series of causal or behavior ategories that have been very generally introduced nto our educational system.

If, as an alternative, it is assumed that the elecron-proton entity is a manifestation of psychical ctivity, but that the psychical processes act in conormity with what are known as physical and chemcal laws, this shifts the emphasis to the physical onception, and the psychical entity becomes an epihenomenon. In other words, a monopsychism is cientifically and socially inert unless it postulates sychical laws and entities which are virtually idenical with our present mathematical and biophysical

laws. No psychical law which is contradictory to physics has ever been adopted. The best known psychical law ever formulated, the law of the association of ideas through similarity, contrast, spatial contiguity, and temporal contiguity, lay practically dormant until the physiology of the nervous system had reached such a state of development that the association of ideas could be related to the association between neural (physical) processes. Mental or psychical elements must be hitched to biophysical elements of some sort to receive scientific recognition. If it is urged that scientific recognition is not essential, or that science must modify its conceptions to include a technique adapted to psychical investigation, we have only to consult the historical development of science to be convinced that as the modern conceptions of physical science develop, the older animistic or psychical conceptions are displaced.

The sciences of alchemy, astrology, earlier medicine, the older biology and geology based on special creation, which either explicitly or implicitly assumed a psychical factor of some sort, have been replaced by sciences which do *not* accept a psychical factor. Such questions as: What are the elements of consciousness? How strong is a particular degree of attentiveness? Is a particular emotion of fear less or more intense than some particular emotion of rage? What is the difference between a strong will

ınd a weak will? What was the motive underlying ı given form of conduct? etc., are problems which ıre simply not being solved. This does not mean :hat no advance is being made in the explanation ɔf human achievement. It merely means that the ɔsychical problem is vanishing, and is being replaced ɔy studies in which human behavior is regarded as ı form of motion and human achievement the prod-ıct of these motions. Even biophysical explana-:ions of so-called psychical phenomena are much nore readily accepted and agreed upon, than ex-:lusively psychical explanations. In recent text ɔooks, memory as a property of the nervous system ıas superceded the explanation of memory as a ɔsychical grouping of "images of the past." Of :ourse, new psychical categories may be developed ɔut the fact remains, that historically, the physical ɔr mathematical categories always have displaced vhatever psychical categories were established. The .onger a particular branch of science has been es-:ablished, the less recognition is given a purely psy-:hical or "vital" factor. The series physics, biology, ɔsychology, sociology, illustrates not only a histor-cal succession, but a succession in which the so-called ɔsychical factor becomes less dominant as we regress :oward physics and especially theoretical physics.

From the behavioristic point of view human ıchievement as the product of purely physical pro-

cesses seems to me to be inevitable from a consideration of the facts revealed by the history of psychology.

Psychical Causation Unnecessary

Since a psychics without a physics seems to be impossible or inadequate, behaviorism has adopted the working hypothesis of a physics without a psychics. If there can be no psychosis without a neurosis, perhaps the psychosis *is* a neurosis. When the experimenter in an introspective experiment records the so-called psychical or mental processes reported by his subject, it is simpler to assume that he is recording only the biosocial character of the sound waves which his subject's speech organs are producing, and that these sound waves represent the interaction of environmental conditions and physiological processes of the same order as those involved in the kymograph record of digestive peristalsis. When the experimenter records his own so-called mental states, it is simplest to assume that he is indirectly recording the effects of biophysical processes of a specific kind, occurring in his own body, but which ordinarily cannot be recorded by anyone but himself. The analysis of these so-called introspective reactions into their sensory-cerebro-motor and biosocial antecedents will completely explain their occurrence, without recourse to a psychical entity. To

assume that digestive processes are functions of physical energy interchanges and that other movements (the verbal report of an introspection) are records of non-physical processes (mental states) is a useless complication of the theory of human behavior. Human behavior or human achievement for the behaviorist is the *function* of the sensory-cerebro-motor mechanism, in the same way as respiration is a function of the lungs, and digestion is the function of the alimentary tract. To assume that there are psychical processes in addition to physical processes introduces into the study of human behavior an entelechy which has not been able to maintain its status in the other sciences, and which cannot be introduced either as a constant or a variable into the mathematical description of human behavior.

From a wider horizon, to assume that electrons and protons are psychical constructs developed by the organism does not result in forms of activity which survive and become incorporated into educational practices. That our knowledge of human chemistry is very fragmentary the behaviorists appreciate perhaps more keenly than anyone else. To try to hide this ignorance by introducing into the account of human behavior some form of a non-material psychical energy which does not register on the precision instruments, is merely complicating

the problem. An animistic or psychical theory of human behavior was the only acceptable theory so long as man's knowledge of the actual behavior mechanism (sensory-cerebro-motor system) was fragmentary. With the development of science, the relations between an environment and the responses that individuals make to it, become more readily understood. Sometimes this relationship is not clear; we are overwhelmed by our ignorance; but why not accept this as a fact as is done by all scientists, instead of reverting to verbal responses acquired during our adolescent period or developed by the race when modern mathematics, physics, chemistry, and biology were not far enough advanced to make possible any other than a poetic or animistic theory of human behavior?

Psychical causation that is not physical causation has not been able to maintain its position, and seems to become less adequate to the extent that biosocial and biophysical analysis becomes more adequate.

THE INDIVIDUAL AND SOCIETY

CHAPTER III

THE INDIVIDUAL AND SOCIETY

Teleology and the Individual—Psychical Causation Derived from Teleology—Biophysical versus Biosocial Equivalence—The Individual or the Organism—The Environment—Human Endeavor an Extension of Biophysical Organization.

Teleology and the Individual

Originally the term teleology was restricted to philosophy. It referred to a doctrine of final causes or design, as applied to the existence or development of human beings or to the universe at large. Teleology assumes that events are not mechanically related as cause and effect but that there is a culminating anthropomorphic condition or millenium toward which everything is approaching. The various stages in this progression were originally thought of as related to human conduct and to achieve whatever destined end was anticipated, the actions of the individual required guidance to keep them going in the right direction. This earlier anthropocentric principle is now disregarded by physical science but social science has scarcely emerged from its influence. The slowly developing conviction that none of the contractile processes which constitute human

behavior and all human achievement will occur unless acted upon by a physical nervous process, calls for some mediating agent between a quasi-religious teleology and the apparent mechanism of human movement. As to the properties of this medium we have only the general lament that, "If our knowledge were more complete, if our science were more perfect, if our faith were stronger, all inconsistencies would disappear." It seems, however, that as science develops the inconsistencies grow greater rather than less, and that as long as human achievements are regarded as partial fulfillments of teleological requirements, unpredictable controlling factors will be introduced, no matter under what pseudo-scientific terms they may be masked.

When man first began to investigate his own behavior and to establish principles of human existence, he regarded himself not as a biological organism but as a distinct creative unit controlled, if at all, only by forces which he designated by such terms as inspiration, faith, spirit. The development of modern science has tended to throw more and more doubt upon the existence of such forces.

Traditional teleology, regarded as a social experiment, has been tried in all the variations that are characteristic of the best scientific methods. Large groups of men have agreed upon the nature of their origin and destiny. But this agreement

soon was lost and special sects appeared. Other large groups were practically without a teleological plan and into these specific superstitions were soon introduced which supplanted the original homogeneity. A glance at the religious situation of the world at present can only lead to the conclusion that teleology has been given a fair trial and found wanting. Science is the hope, not the despair of mankind. If it were possible to create for science and for scientific research the same confidence and support that at one time in its existence was extended to any given religious creed, human maladjustments would soon vanish.

Psychical Causation Derived From Teleology

In the older psychology those actions which establish the individual's social status are regarded as being *controlled* by mind, consciousness, or some other psychical agent. Antedating this, the soul or ego performed about the same function. The introduction of consciousness seems a necessary step to give to teleology some scientific principle for the application of mathematics and experimentation. The comparative study of teleological systems, however, shows so many of them to be contradictory that the infallibility of any one of them becomes doubtful. If human achievement is to be regarded

even in part as the product of some quasi-religious destiny, some anthropocentric directing influence which is constantly guiding the events that occur must be postulated. The variability of human conduct makes it seem unlikely that man is in rapport with any super-cosmic intellect, and if man's actions are merely the result of biophysical and biosocial antecedents, the need for a non-material guiding principle (purpose) vanishes.

The only justification for the assumption of a psychical guiding force in human behavior is based upon the conviction that the destiny of human beings cannot be determined through scientific investigation. As the behavioristic conception that man is only one stage in cosmical evolution is more generally adopted the conception of an anthropocentric teleology will be replaced by material science.

For most psychologists the preceding remarks are already platitudes when considered in an analytic spirit, but if we actually eliminate the instances in which teleology is *indirectly* accepted in current writings on abnormal, educational, and social psychology, how much of this literature would remain?

Biophysical *versus* Biosocial Equivalence

In discussing the nature of the movement continuum we called attention to the fact that with the introduction of human behavior as a form of motion

a new type of equivalence or equation was introduced. As neuromuscular effects, two responses differ from each other to the extent that the physiological conditions of sensitivity, conductivity, and contractility differ in corresponding receptors, neurons, and effectors. This anatomico-physiological equivalence I have designated as *biophysical* equivalence. When, however, the movements that constitute human behavior are grouped and classified not on an anatomico-physiological basis, but as to their effects *as stimuli for other individuals*, a complete change in the movement groupings occurs. This I have designated as *biosocial* equivalence.[1]

To illustrate: Suppose I am invited to dinner by a friend in a nearby city. I may accept this invitation in at least four (physically) different ways:

[1] In an earlier article ('22b) I used the compound word "individual-social" (instead of biosocial) to describe this phase of the response. I also suggested the use of the term *signal* for the biosocial phase instead of the word stimulus which was to be used only when the muscle-twitch phase of behavior was considered. Warren ('22b) suggests the word *sign* instead of the word signal and objects to the degree of emphasis which I place upon social situations. I trust that the greater detailedness of this book and the modifications that I have made wlll meet Warren's objections. I have dropped the word signal or sign because I believe the terms biophysical and biosocial make the distinction between stimulus and signal superfluous. I had considered using the term *reaction* for the biophysical or muscle-twitch phase, reserving the term *response* for the biosocial phase of behavior. But the real difficulty, it seems to me, is to show the relations between those conditions that I have designated as biophysical and biosocial and if, as I believe, the distinction is important, it may be better to hold to the adjectives biophysical and biosocial until the distinction is established, using the terms bodily movement, reaction, response, action, behavior, behavior series, behavior life history, in an ascending order of complexity in movement.

(*a*) by telephone, (*b*) by telegraph, (*c*) sending a messenger, (*d*) writing a letter. As four sensori-motor conditions all of these responses are different, but when they become stimuli for my friend, all four of them are practically equivalent. This *behavior* equivalence is demonstrated by the fact that if my friend had telephoned my acceptance to his wife, his telephone message to her need not have indicated which of the four methods of accepting I had used. In other words, the four methods of accepting are *socially* equivalent because any one of the four (as a stimulus) would release the *same* response. While as sensori-motor conditions they are *different*, the four methods reveal their behavior equivalence when measured by their stimulating effects on the responses of others (my friend, in this particular instance).

If the study of human behavior is to achieve a scientific status and is to be handled as a segment of the cosmic movement continuum, *both* the biophysical and biosocial properties must be studied. I wish to direct especial attention to the fact that biophysical and biosocial do *not* refer to two *aspects* of the same thing, say the type of sensori-motor organization. The classifications which include responses that are biosocially similar need not show *any* biophysical similarity.

It is not likely that the sensory-cerebro-motor system of man, either as to structure or as to function, has changed very much during the last five thousand years. Some authorities on genetics would say that there may be even a deterioration since the Greeks, on account of a less rigorous natural selection of those who survive in the struggle for existence. The difference between the biophysical and biosocial factors may be illustrated in this way: Suppose that instead of the recent discovery of the undisturbed tomb of Tut-Ankh-amen and its contents, we had found a complete set of neuro-myograms of representative Egyptians of this period. We may even assume these neuro-myograms to be more perfect than anything we might construct today. Would this type of record be regarded as more valuable, or as an adequate substitute for the contents of the tomb as a means for revealing the behavior or cultural history of this period? Or suppose we ask the traditional question, What kind of *minds* did these Egyptians have? or, What was their status in memory, imagination, and thinking? Is not this question to be answered more adequately from the actual products of social activity (the contents of the tomb) than from the neurological analysis of say a perfectly preserved body of some contemporaneous individual? I do not believe that any neurological insight alone will enable us to de-

termine what the *stimulating effects* of a given neuro-muscular configuration will be *upon other individuals.*

It is of course always possible to maintain that our biophysical methods of analysis are still imperfect, that physiology and neurology are not far enough advanced, but I believe this argument applies to biosocial analysis with still greater effectiveness. The method of biosocial analysis has just begun. When the conception of a mind and consciousness will have been recognized as only tautological statements of problems in human behavior, instead of an explanation of behavior, biosocial analysis will proceed rapidly. When we recognize that the phrase, "I responded because I attended," only means, "I responded because I responded," we shall be ready to investigate the biosocial problem of how our responses develop.

I do not wish to be understood as underestimating the value of neurological insight, but the study of human behavior and human achievement demands more than the investigation of the sensory-cerebro-motor conditions, and this more is not a super-physiological factor but an investigation of what I have characterized as the compound-multicellular form of electron-proton organization.

The Individual or the Organism

Biologically the individual is an organized group of interacting anatomical and physiological units in which the processes of growth, nutrition, reproduction, and adjustment take place. When individuals are compared with each other, certain structural differences are found, which are indicated by such terms as: young, old, tall, short, white, black, yellow, brown, blond, brunette, male, female, healthy, diseased, etc. A second class of differences exist which are apparently independent of the structural differences, but depend rather on the *movements* which the individual makes. Such differences are designated as *behavior* differences, and while these, in the last analysis, depend on sensori-motor differences, the antecedent environmental conditions play a more important part.

Behavior differences are implied in such terms as: generous, thrifty, quarrelsome, amiable, religious, non-religious, literate, illiterate, artistic, mechanical, radical, conservative, industrious, lazy, banker, baker, laborer, teacher, professor, historian, psychologist, engineer, etc. The individual from the standpoint of behavior (and excluding the biological factors) we have defined as the sum total of his educational, vocational, administrative, recreational, and personal activities from birth to death.

The Environment

The term stimulus is used to designate those forces which initiate the functioning of the sense organs whether these forces occur inside or outside of the individual's body. A gland or muscle though usually classified as a motor organ, may function as a stimulus by acting upon adjacent sense organs or by releasing secretions into the blood stream which act on remote sense organs. In a wider extension, as in speech, the muscular contractions of the vocal mechanisms may produce air vibrations (words) which may act on the ears either of the individual himself or upon those of other individuals. This dual role of reacting element and stimulating element possessed by muscles permits their classification sometimes as part of the environment, sometimes as part of the reaction.

The environment, from the standpoint of the behaviorist, is the sum total of those stimuli and the patterns in which they are grouped, which are the antecedents for the sensori-motor functions that establish the individual's social status.

Human Behavior an Extension of Biophysical Organization

If the individual is to be regarded as a participating factor in the system of universal change, it is important to determine the place of human be-

havior in the universe. From the standpoint of physics and chemistry man is regarded as a biophysical aggregate of sensitive, conductive, contractile, secretory and supporting tissues, grouped together into the organs and fluids of the body. Within this body the chemical and physical processes known as growth, nutrition, reproduction occur; but these processes, during historic time, seem to have undergone no changes which are at all comparable with the changes in the forms of movements which individuals have acquired. In the discussion of the fundamental principles underlying the behavioristic assumptions, we found what seemed to be a tendency for the ultimate physical units to form groups of greater and greater complexity. Electrons and protons combined to form atoms, atoms to form molecules, molecules to form compounds, minerals, etc. However, there is a limit in size beyond which the inorganic type of organization becomes unstable under the temperature and pressure conditions existing on earth. Thus the large radium atom contains fewer than two hundred electrons and protons and its lack of stability is demonstrated by the throwing off of some of its electrons and protons, which may recombine to form the less complex but more stable atoms of lead and helium.

According to D. W. Thompson ('17) the relatively large organic albumen molecule is a thousand

times larger than one of its inorganic sulphur molecules. The smallest protoplasmic units such as the bacteria contain in the neighborhood of 30,000 albumen molecules (p. 41). The protoplasms seem to be an extension of the inorganic and organic combinations which preceded their formation. According to Loeb ('12), "The essential difference between living and non-living matter consists then in this: the living cell synthesizes its own complicated specific material from indifferent or non-specific simple compounds of the surrounding medium, while the (non-living) crystal simply adds the molecules found in its supersaturated solution" (p. 23). According to Chambers ('18) the protoplasmic type of electron-proton organization is one in which a limiting membrane or locus is maintained between the protoplasmic elements and what we may call the first stage in the differentiation of an environment. Just as there seems to be a limit to the size and complexity of the organic molecule beyond which it becomes unstable, so, according to D. W. Thompson ('17) the protoplasmic cell seems to be limited to an optimum size in which the ratio between surface and mass maintains a balance between the surface energy and the other energies of the system (p. 35). If the mass becomes too large the surface of the cell becomes too small (proportionately) to present the most favorable conditions

for protoplasmic metabolism. As long as the protoplasmic units remained independent of each other, as in the protozoa, bacteria, etc., the size and complexity of organization was limited. However, these limitations were overcome when multicellular structure was developed. The protoplasmic units, the cells, still remained about the same size but the multicellular aggregates developed that variety of form and complexity which makes up the plant and animal kingdoms of the present era. But there also seems to be a limit to the size and complexity of the multicellular form, as is evidenced by the gradual extinction of the prehistoric herbivora, some of which enormously exceeded in size any existing form. In these prehistoric forms the multiplication of protoplasmic cell units had reached such a size that favorable nutritive conditions could not be maintained throughout the life cycle of the organism.

The next step in extending the range of cosmic organization was through an increase in the complexity of nervous structure, and especially of the modifiability of the interconnections between the sensory and motor structures of the body. The final result of this increase in the complexity resulted in an enormous increase in the complexity of the movements and introduced organization between multicellular organisms. From this there de-

veloped a functional continuity between multicellular units without an anatomical continuity. This type of organization I have designated compound-multicellular organization and it represents the beginnings of the co-operative interactions between individuals that has been given the name of social organization. This type of organization simplified the nutritive problem because it made possible a specialization of labor in securing and storing food and producing better shelter. In mankind we have a multicellular form in which the *inter*organization has progressed further than in any other multicellular form. Some of these organizations are described by such names as the family, the tribe, the fraternity, the community, the race, the state, the nation.

The possibility of increasing the size and scope of these larger organizations depends on the variety of movements that man can learn. The larger the community, the more specialized do its various activities become and thus create opportunties for inheritance types which could not survive under the more uniform environmental conditions of smaller communities. Human behavior and especially its degree of variability, seems to be another device through which the principle of electron-proton organization is extended in complexity and size beyond the limits set by the multicellular types of organisms in which organization is limited to an

anatomical continuity between the specialized cells.

In the relatively unsocialized animal the specialization of the different tissues produces a higher degree of co-operation between the various parts of the body, but this interdependence of the various tissues may become so complex that the frequency of fatal abnormalities becomes too great. In multicellular organization the inadequate function of a single organ kills the whole organism. In compound multicellular (social) organization, even though the individuals are very highly specialized for certain necessary activities, the death of one individual does not disturb the particular social institution to as great an extent as, say, tuberculosis will reduce the effectiveness of the bodily organization. In other words, the difference between man and the animals lies in man's greater behavior potentialities, which have made language possible and this in turn made compound multicellular organization and sensori-motor interchangeability among individuals possible.

THE DEVELOPMENT OF THE INDIVIDUAL

CHAPTER IV

THE DEVELOPMENT OF THE INDIVIDUAL

The Developmental Series—Variability in Behavior is Fundamental—Hypothetical Conditions for Maximum Variability—Restrictions against Variability: *1 The Limitations of Disease and Death; 2 Limited Sensory Capacity and Restricted Environment; 3 Limitations Through Faulty Inheritance; 4 Limitations Through Food and Shelter Activities; 5 Limitations Imposed by Competition.*

The Developmental Series

At birth the internal stimulating conditions that act on the infant release mainly the vegetative processes concerned with nutrition and growth. The external stimuli such as changes in temperature, lack of food, local pressures, strong lights, loud sounds, release such infantile reflexes as crying, kicking, slashing about. With further physiological development and growth the discriminative reactions to environmental stimuli become more detailed and specific as in the grasping, localizing, vocalizing, and the facial expression reflexes.

When the child begins to move about, reactions to the *combinations* of stimuli, and to successive and simultaneous *relations* between stimuli, are devel-

oped. By the arbitrary combination of stimuli, nurse and parents produce further variations in the direction of the more conventionalized forms of behavior. The feeding reactions, for instance, pass through successive stages in which parent or nurse function as a variable stimulus factor which modifies the inherited feeding mechanism by slow changes until the child eats in the manner of the adult.

The changing life conditions of the child and the type of sensory-cerebro-motor system that it possesses, produce a gradually increasing repertory of discriminative responses of which the most important is that of language. This enormously increases the number and range of the stimulating conditions that become available for the modification of behavior. The child meets other persons, other children, sees street cars, automobiles, plants, animals, buildings, etc., and learns their names. He attends school, parties, picnics, games, and develops the responses appropriate to these occasions. He learns to discriminate between objects and the relations between objects, and between objects which belong to him and those which belong to others.

The sensori-motor conditions may be regarded as the result of a series of constantly changing stimulating conditions acting on a practically limitless number of receptors that are connected with an effector system of enormous complexity through a

system of interconnecting neural elements. Functionally this represents a limit of sensori-motor organization in which every receptor is connected with every effector, but *not* through equal degrees of neural resistance. Some of the more direct sensori-motor patterns represent germinal or inheritance conditions which are classified into the so-called instinctive tendencies, emotional types, specific traits, and individual capacities. On the motor side the development consists in an increase of the number and variety of responses to stimulus combinations.

At the age of adult maturity the child has acquired an enormous number of responses to many objects and to many relations between objects. In general these activities can be grouped under the educational, vocational, administrative, recreational, and personal activities of the individual.

At the approach of senescence the number and the variety of the responses begin to decrease until a stage may be reached in which only the vegetative processes remain.

The whole series of responses from birth to death represents the behavior life history. From a few relatively simple reactions at birth, are developed the practically limitless series of differentiations and discriminations of adult maturity. After a maximum variability there is a gradual reduction until

at utter senescence there is again an approach toward the infantile behavior conditions.

The development of the individual may thus be regarded as a result of the interaction between the tissues (especially the nervous tissues) which make up his own body and the stimulating effect of the environment. His behavior in the last analysis is of the same order as the physical and chemical processes which make up the totality of cosmic change and interaction.

Variability in Behavior Is Fundamental

Variability seems inherent in the constitution of the universe, and while there may be periods of relative inactivity, they can be of only short duration in a cosmical sense. In the evolution of organic life variability in behavior was largely dependent on variation in the anatomical and physiological structures. With the development of the human sensory-cerebro-motor system the range of variability was enormously increased with practically no change in the other anatomical structures and physiological processes that are involved. Complexity and variability in organization is the result of a series of less complex and less variable antecedents. The degree of stability in organization at any point in the universe is only relative and temporary. At

intervals which may vary from a fraction of a second to centuries, changes occurring in regions of varying degrees of remoteness upset the stable equilibrium of any given system and produce the conditions for the disruption of the existing systems and the reformation of more complex aggregates out of the products of the disruption. The new type of organization that is produced, again approaches relative stability until it is again disrupted and reassimilated into a still larger organization.

Human behavior may be regarded as an effect of this cosmic variability, and as the cause of still more complex organization. The human organism is a locus of complex electron-proton systems, the changes within which approach a higher and higher degree of correlation with all other changes occurring in all the other electron-proton systems in the universe. The phylogenetic path of human behavior supports this view. No other agency has changed the face of the earth as much as man, when proper allowance is made for the relatively small proportion which his body bears to the totality of the energies and masses involved, and no other agency has united so many organisms into an interacting complex. If variability in behavior is the result of a biophysical trend toward greater and more complex aggregates of the ultimate physical

units, then complexity in biosocial organization is not an adventitious effect of man's presence but an essential process in cosmic evolution. To hazard a guess at the final stage in cosmic evolution beyond that of its probably being cyclic in character, is of course futile under our present scientific limitations. Granting that variability in behavior produces larger biosocial aggregates, variability then becomes an essential condition for biosocial survival unless human organization modifies the workings of those physical processes which, up to this time at least, have produced a progressive series of changes of which each succeeding change dominated and assimilated the preceding changes.[1]

However, before the human race will be sufficiently organized to restrict its own numbers and its own variability in conformity with some scientific plan, variability in behavior will be one of the factors in race or national survival. The attempts to base behavior on the operation of so-called psychical forces, or "drives" which conflict with the biophysical principle of variability, or which anticipate a permanent and invariable "ideal" social organization, are not in conformity with the evolu-

1 Thus coal at one time represented a relatively independent aggregate of electron-proton systems, but with the development of compound multicellular (social) organization, its method of changing its composition has been altered from that of geologic erosion and transformation, to that of being used as a fuel under boilers and in furnaces.

tionary principles which can be demonstrated as acting wherever the natural science methods have been used as a basis for analysis.

One of the most fruitful principles in scientific explanation is to limit the assumptions that are made, to those principles that were in operation before the changes which are to be explained, occurred. Thus if a psychical force is operative in man either the psychical force itself or the elements from which it is derived, should have been in existence before man appeared. The attempt to prove or disprove this, known as the problems of the origin of mind or consciousness, has been one of the most barren chapters in philosophy.

Hypothetical Conditions for Maximum Variability

Before considering in detail the conditions which augment or support variability, an illustration of maximum variability (even though hypothetical) will help in understanding the problem. To secure the maximum variability in the behavior of an individual requires a certain optimum set of stimulating and reacting conditions. The uncivilized individual is limited in the variety of his reactions because of the limited range of his sense organs. At best, he can react only to objects within his visual range, a distance of hardly more than a few miles. If an

ideal individual existed whose eyes could, at any moment, see all the events that have occurred in the past, that are now occurring all over the world or that will occur in the future, such a superman would exhibit a diversity in his behavior far beyond that of any normal man. With such eyes the visual environment of our superman would be enormously more varied than that of the normal individual. Physically we could express this fact by saying that the visual sensori-motor mechanism of the superman possessed a higher degree of correlation, than that of normal man, with remote (both temporal and spatial) changes. Eyes like those of the superman are of course a physical impossibility but certain social conditions (cinema, painting, photographic reproductions) really make it possible to approach this all-seeing condition. Suppose further that our superman possess perpetual youth, absolute immunity against disease, the best possible inheritance, unlimited physical strength, and unfailing food and shelter resources. His sensori-motor conditions would then exhibit a maximum degree of correlation with adjacent and remote environmental changes. This condition would approach perfect biophysical equilibrium between the environment and the superman, or in terms of social organization, a perfect adjustment between the individual and the environment.

Compared with the normal man, the superman may be characterized as possessing a higher degree of omnipresence, omniscience, and omnipotence. In the cosmical sense the superman is an aggregate of electron-proton systems whose changes exhibit the maximum degree of correlation with the changes that are occurring or have occurred in all the other electron-proton systems in the universe. *Homo sapiens* approaches the variability of the superman to a greater extent than does any other animal, but even the best endowed individual is far from the ideal.

Early life was individualistic. Each plant or animal grew and thrived according to its available food supply,—ignoring those forms which did not compete directly, avoiding those forms which destroyed it. In so far as there was a social plan in behavior this was one of *symbiosis* or *parasitism*. Out of this developed the *exploitation* either of sub-members of the same species or of other species, as is exemplified in the colonies of bees, ants, wasps. In man exploitation has reached a high degree of perfection, involving not only members of the same species but all animate and inanimate resources. Along with this, *co-operation* developed between members of the same group (family, tribe, nation) at first directed toward the exploitation of adjacent organizations and individuals, but gradually ex-

tending its range to include larger and larger social units. Social organization has become a device through which the sensori-motor equipment of one individual is placed at the disposal of other individuals in the organization, and it is this interchangeability of receptor-effector functions between individuals, that I have designated as co-operation.[2] In man co-operation has made the human response both an individual and a social event.

The actual neuromuscular factors that are involved in human behavior are relatively unimportant as compared with the *stimulus character of the response for other individuals.* This is the characteristically human element in human behavior, and gives us libraries, telephones, telegraphs, historical records, which in themselves are the sensori-motor effects of individuals now gone. When human responses are investigated on the basis of their effects as stimuli for other individuals in addition to their neuro-muscular characteristics, such conceptions as consciousness, mind, mental, psychical, will simply vanish. Because many neurological principles have not yet been isolated does not imply that the investigation of human behavior must languish until they are. Human behavior or human

2 I do not wish to imply that present social organization has gone very far in the *free* co-operation between individuals. Much of our present co-operation is only a more effective form of exploitation.

achievement is merely the product of conditions in which the range and complexity of electron-proton organization is extended beyond that of the multicellular form. The disadvantages of a variable, perishable, spatially and temporally limited sensorimotor system, are being reduced through the survival of those stimulating conditions (the social environment) by which *social* evolution is replacing organic or individual evolution. Social organization is one of the devices through which the limits of individual variability in behavior are extended.

Restrictions against Variability

The most important conditions which limit the variability in the behavior of the normal individual may be grouped under five headings: (1) The limitations of disease and death; (2) Limited sensory capacity and restricted environment; (3) Limitations through faulty inheritance; (4) Limitations through essential food and shelter activities; (5) Limitations imposed by the competition between individuals.

While with respect to any of these limitations we find an improvement between primitive and modern conditions yet the improvements are not always progressive. We cannot say for instance that the presence of a given social organization represents a particular culture. Social development is

not a regular process from the simple to the more complex. At one time in a given community rapid progress may be made in medicine, while other forms of organization are standing still or even going backward. Social progress, viewed as a current phenomenon, is a very much up and down affair; it is only over centuries and as a whole that it exhibits the gradual trend toward biosocial complexity and sensori-motor interchangeability between individuals which we have regarded as its basis.

To anticipate our conclusions we may provisionally regard human institutions and organizations as agencies by which man actually overcomes some of these limitations; and that social reform or social changes are directed toward developing the one best type of organization that will make it possible to secure the maximum variability for each individual and thus produce indirectly an electron-proton organization which approaches the omnipresence, omniscience, and omnipotence of the superman we have used as an illustration. We pass on to a consideration of the extent to which social organization has already overcome many of the limitations against the maximum variability in behavior.

1. The Limitations of Disease and Death

Under favorable conditions the span of human life is in the neighborhood of seventy years,—the

average length about fifty. It is clear that if an individual lived to be three hundred and retained perfect health during this period, the variety of his behavior would be greater than it now is. Under primitive conditions most individuals died a violent death and the continuity of social organization was frequently disturbed by epidemics. Disease and death were regarded as the work of non-material forces such as evil spirits, demons, or as punishments for infractions against the will of some supernatural agent. The preventive measures were mostly directed toward propitiating some mysterious influence of a supernatural character. The variations between the individuals who became the medicine men led to inventions and improvements which displaced the original supernaturalistic technique by the modern methods that are characterized by a strictly biophysical technique, in which disease is regarded as due to partly controllable biophysical antecedents. Through the innate variability of the best endowed individuals and the record of their successful responses, medical research has developed therapeutic methods which have displaced the ritual and magic of the primitive medicine man.

The following represent a few of the social institutions and co-operative forms of behavior which reduce disease and delay death: medical schools, medical societies, hospitals, boards of health, the rapid

dissemination of preventive information in epidemics, quarantine, vaccination, sanitation, clinics, community physicians and district nurses, safety-first methods, vital statistics.

These institutions can only exist under a very complex form of social organization. The average duration of life has been extended, the variability of behavior has increased, and to this the institutions have contributed toward what seems to be the inevitable trend toward larger groupings of individuals. It is questionable whether even the most advanced medical practice and organization represents the one best form of organization that will most effectively remove the limitations imposed by disease and death from the greatest number of individuals. Such very effective methods as the control of disease and death through the control of heredity have not even been tried. Whatever may be the ultimate development of medical science, it seems reasonable to suppose that medicine is a factor in social evolution which is contributing toward the complexity and variety in human behavior both for the practitioner and the patient.

2. *Limited Sensory Capacity and Restricted Environment*

Anatomically the sense organs of man are of the same general type as those of the animals. He

sees, hears, smells, tastes, feels, in about the same way,—in some cases more accurately, in others less. The animal is limited; qualitatively, by the lack of sense organs for the discrimination of such physical relationships as electricity, magnetism, certain forms of radio-activity; spatially, by the fact that a radius of at most a few miles represents the maximum distance at which a stimulus may act; and temporally, in that only the stimuli that occur in the immediate present can be effective in modifying its behavior. Compared with the savage, civilized man has enormously extended the range of his sense organs and his environment by the perfection of language. Through language man is able to produce within certain limitations, environments that have occurred in the past or may occur in the future, or which are occurring now but are beyond the limit of direct observation. Thus by historical records man may at any time reproduce situations that occurred centuries before he was born. Through representative art he can extend his environment to any part of the earth. Through telephone and radio he extends his auditory range. Through advanced weather reports he is able to adjust himself to temperatures that will not act on his cutaneous receptors for many hours.

Contrast this with the limited sensory range and restricted environment of primitive man and we see

how the range of modern behavior is extended, not only for the individuals who use the devices but also for those who develop and produce them. These inventions and the social organization through which their products are distributed have the virtual effect of placing the sense organs and environment of every individual, living or dead, at the disposal of every other individual. We have learned how the past, present, and future, the near and the far, can be reduced to library dimensions.

The following devices and institutions extend the sensory range and the environment of civilized man and thus produce greater variability in his behavior: formal historical records, and the many forms in which language manifests itself,—books, newspapers, magazines, photographs, illustrations, cinema, microscopes and telescopes, telephone, radio, power travel.

It is only by marshaling such an imposing list of social achievements that we get an idea of how the development of compound multicellular organization and language has made possible a degree of interaction between organisms entirely beyond any purely anatomical and physiological possibilities. Social organization in the realization of its potentialities seems to be directed toward uniting all men into one gigantic organization, the individual units of which are multicellular organisms exhibiting both

uniformity and variety in their behavior, and which in cosmic terms are complex electron-proton aggregates.

3. Limitations through Faulty Inheritance

Under any given set of educational conditions all the individuals do not develop the same responses. A few individuals meet new situations by improving upon established forms of behavior; the majority learn the conventionalized reactions sufficiently well to meet a minimum requirement; a few do not even meet these minimum social requirements. There are thus differences between individuals that are traceable to differences in the type of nervous system that is inherited, and these differences may range from an imbecility which would result in the speedy death of the individual if left to himself, through various stages of social dependence and independence up to the individual who invents and discovers new forms of behavior better adapted for the survival of either the individual or the group than those that have been established through tradition or have become a part of the educational system. Excellence in inheritance thus manifests itself as a quicker learning and an improvement of the standardized responses. Good inheritance has been recognized as such an important factor in social adjustment, and as occurring so rarely, that most individuals are taught to *imitate* the behavior of the

well-endowed, rather than to rely upon their own innate ability for adequate adjustment to a more or less variable environment. This results in behavior that is considerably above the average inheritance level of the group. Factory methods make it possible to produce cheaper and better products with workers of poorer inheritance and training than did the older handicrafts.

The modern development of industry is in the direction of specialization so that even the most complicated production (e. g. an automobile) is divided into partial activities which individuals of even the most limited training and all but pathological inheritance can learn in a few hours. This enormously restricts the variability in behavior to all but a few of the individuals who do the planning and organizing. However, because of the reduction in the cost of the factory product it may become available and thus contribute to the variety in the behavior of a larger proportion of the individuals in a community than under handicraft conditions.

The home, tradition, law, education, division of labor, etc., make it possible to use types of inheritance that would be speedily eliminated under more rigorous primitive conditions. While much has been done by training, no scientific attempt has been made to improve the germ plasm of mankind.

4. Limitations through Food and Shelter Activities

Under frontier conditions practically the whole time and energy of the family are devoted to securing food and shelter which are of the simplest kind. One of the first steps after social co-operation has begun is to establish some kind of religious or educational activity which introduces variety into the behavior of the younger generation and prepares them for participation in the more variable forms of behavior to be found in more socialized communities. Roads and transportation facilities are improved and through the division of labor and the use of machinery the time and energy devoted to food-getting are much reduced. The greater leisure is expressed in a greater variety and better quality of food and shelter, and in the development of recreational forms of behavior. Perhaps in no other field of human activity has social organization produced such variety in behavior as in the preparation of dress, food, and shelter.

It is difficult to name a social activity that is not in some way related to food and shelter, but among the more important institutions which reduce the time and energy devoted to securing them we may mention: factory methods, transportation, refrigeration, improved agriculture, improved housing, and such indirect methods as insurance, pensions, etc.

From even a hasty consideration of the complex-

ity and variety of institutions such as those mentioned, it seems evident that biological evolution beyond the huge multicellular forms of the prehistoric herbivora has taken the form of an increased complexity in behavior, and this in turn is secured through an increase in the relative amount of nervous tissue. If we are correct in assuming that cosmical evolution, in so far as this term has any significance, is in the direction of the formation of larger and more complex aggregates of organized electron-proton systems, the activities of the highly individualized multicellular form known as man, exhibits this tendency in his food and shelter behavior in an almost irrefutable clearness.

5. *Limitations Imposed by Competition*

While competition introduces variety into the behavior and develops inventiveness for a few of the abler members of the group, too large a proportion of competitive effort has the effect of decreasing rather than increasing the community's resources upon which the individual depends for a greater amount of leisure in which to develop more individualized forms of behavior. Under primitive conditions where social organization is limited to rather small groups, competition in the shape of war may take up all the time and energy of a considerable part of the group. Even under modern

peace conditions there is a constant lack of balance between the commodities that are produced and those that are consumed. Over-production and under-production alternate in a bewildering fashion and produce a degree of insecurity which results in constant waste and in the extreme case, in war.

Social organization has made least progress in the elimination of useless competitive behavior. The most effective instrument, that of scientific social research, has scarcely been introduced. Such institutions as civil service, vocational or specialized training, labor unions, employers organizations, producers organizations, trusts, treaties and agreements, have eliminated or regulated competition between particular groups of individuals, but this is usually nothing more than a transference of the evil effects of competition to a less well organized group. Thus the coal operators may combine to limit competition among themselves, the miners may organize for higher wages, but there is no decrease in the cost of coal to the unorganized consumer. The enormous waste involved in advertising practically doubles the cost of the advertised article.

As compared with engineering, modern business methods have reached a degree of ineffectiveness and waste so far as social organization is concerned, which is rapidly taking business out of private control and making it a community enterprise. How-

ever, business methods are a first step toward a more equitable distribution of the natural and social resources which will eventually result in greater variety and greater independence in the behavior of all individuals.

THE INDIVIDUAL AS A SOCIAL UNIT

CHAPTER V

THE INDIVIDUAL AS A SOCIAL UNIT

Limited Variability—The Innate-Acquired Components in Behavior—The Innate-Acquired Balance—Happiness — Man's Supernatural Destiny — Man's Biosocial Destiny.

Limited Variability

Social organization, we have seen, increases the variability in human behavior by: reducing the restrictions of disease and death, extending the sensory range, expanding the environment, overcoming faulty inheritance, increasing food and the security of shelter, and regulating the competition between individuals. We profess to see in all this a cosmical evolution of electron-proton aggregates into a greater and more complex organization of which a league of nations may be regarded as a future limiting condition, under which every individual would exhibit a maximum variety in his behavior.

But the federation of social activities is not smooth and continuous. At times, and for limited groups or nations a return to less organized conditions may prevail. This is true not only in war but may manifest itself under peace conditions. As economic pressure is removed man's behavior often becomes less rather than more variable. It seems that if the in-

dividual works less he will idle more. For most persons more leisure is merely an opportunity to *catch up sleep* or to secure the required rest for adequate metabolism. Furthermore the daily routine task is not the one an individual would perform if inheritance and an irresponsible immersion in a social environment were the only stimulus for behavior.

For effective co-operation with others the innate components of behavior must be modified and changed, and this requires time. Ordinarily the training for socialized behavior actually raises the individual above his own inheritance level and any economic or industrial changes which result in more leisure will be accompanied by a *relaxation* to forms of activity that are nearer the individual's earlier or unmodified inheritance level. To expect a laborer to spend any leisure which comes to him through labor saving machinery in "improving his mind" would imply that his education has already placed him above his work. Under present conditions this is rarely the case and a relapse into more primitive and instinctive forms of behavior is the rule.

While social organization and education are eliminating mutual exploitation and developing more effective co-operation between individuals of a particular class, the exploitation of one class by another largely neutralizes any gain to the individual. A well balanced, secure and active life, is still too

much a random and fortuitous event to warrant the assumption that individual freedom in behavior is the rule rather than the exception.

The Innate-Acquired Components in Behavior

The change from infantile to adult behavior varies in two directions: (1) the behavior comes to resemble more and more the behavior of a particular class or group of individuals and thus reflects more and more the social status and the type of community, (2) the behavior becomes more individualistic and reflects more clearly the inherited sensori-motor type.

Beginning with the movements of a new-born infant which are to be regarded as reflex sensori-motor mechanisms either inherited or of embryological origin, there is a gradual increase in the number and complexity of those movements that make up behavior through youth, maturity and old age. The adult response to the environment at any given instant may be regarded as one stage in a changing series of responses which (a) trace backward to infantile reactions and (b) forward to a terminal stage in the daily life of the individual. The *behavior* at any given instant may be regarded as a *unified* group of response segments derived from different series of responses. The character of each series (the behavior of the individual) is the result of

the environment and inheritance, classified into innate and acquired components according to the following categories:

The Innate Component (Inheritance)	The Acquired Component (Education)
1. The type of nervous system that is inherited: Mechanical, artistic, gentle, pugnacious, etc.	1a. The type of sensorimotor modifications that represent intersocial relationships: Obedience, respect, provincial, cosmopolitan, etc.
2. The responses to stimulating conditions that represent the primitive and relatively unsocialized environment: The out-of-doors, field, hunting, tramping, etc.	2a. The responses to the most recent and most socialized environment: Home, school, office, factory, society in general.
3. The type of response designated as an "end in itself": Recreation, play, invention, etc.	3a. The type of response designated as a "means toward an end": Routine, system, preparation, planning, acquisition of skill and accuracy.
4. The types of responses that develop independently of the cultural or anthropological status of the group: Mating, food, shelter, self-defense.	4a. The types of responses that depend on the cultural or anthropological status of the group: Ceremony, vocation, profession, special forms of cooperation.

Every adult response begins as some infantile reaction in which the inborn or innate component predominates. The subsequent stimulating conditions change the infantile reactions through the addition, elimination, or substitution of other movements and the resultant becomes the so-called acquired component. The adult act represents a terminal stage in a regressing series of changes which began with some original or first response.

Theoretically it should be possible to trace back every adult act through a series of antecedent steps to some infantile source but the antecedent of each change is usually a complex social situation which as a stimulus, carries with it so many historical and cultural antecedents that an analysis of its immediate sensory elements (visual, auditory, kinesthetic, etc. attributes) is entirely inadequate to account for the change. The further back the analysis of a response is carried the stronger does the innate component manifest itself. The nearer the series approaches the present, the stronger does the acquired component become and the more effectively does the action establish the social status of the individual. The behavior of every person who participates in the work-a-day activities of the community is being constantly socialized but the process of socialization is always super-imposed upon and limited by an in-

nate component which individualizes the conventional forms of behavior.

The adult response may thus be regarded as a synthesis of two components: (a) an innate (biophysical) component which represents the inherited sensori-motor properties, and (b) an acquired (biosocial) component which represents the effect of the complex social stimulating conditions under which the individual develops.

The Innate-Acquired Balance

The behavior life history of the individual is the product of a series of interactions between the innate and the acquired components that are the antecedents of any given response. In man those stimuli which are grouped together as the formal and informal educational system have become stronger stimuli than those which represent the natural or non-social system. This means that our social organization from the very beginning presents stimulating conditions that socialize rather than individualize behavior. The socialized stimuli do not act with equal effectiveness on all individuals and the degree of change from infantile to adult forms of behavior is unequal. There is, so to speak, a constant transition from the established forms of responding, to newer forms. Often it is impossible to differentiate the stimulating and the neural con-

ditions which are involved, but when the innate component predominates the transition is made more rapidly, more skillfully, and with less expenditure of energy than when the acquired component predominates.

As a problem in social organization we may agree that the more the innate component can be made to contribute to socialized behavior the nearer do we approach the maximum effectiveness of the individual as a co-operative unit in a given social organization. For most effective co-operation the individual must act on a schedule and his behavior must fit into a system which may deviate widely from his innate type. The greater the deviation the greater will be the number of *repetitions* necessary to acquire the socialized behavior and consequently the less varied will be the individual behavior. The ideal conditions would be those in which the unmodified innate responses would fit into some phase of the social plan. Such an ideal synchronism between the innate and the acquired components occurs very rarely, but for each individual there is an optimum compromise. Thus to make a professional musician out of a child whose innate musical ability is low will require more supervision, training, and repetition per unit of improvement, than for a child who has inherited musical talent and in whom the innate component for musical responses is high. If,

further, society is organized so that the musical individual is able to use his innate talent to meet some social requirement as in teaching music, musical composition, conducting an orchestra, etc., this individual will reach a given degree of co-operative effectiveness in a shorter time than if he were required to contribute his co-operative exchange through some form of behavior requiring a larger acquired component.

Speaking generally this means that society may be so organized that the individual's innate endowments may contribute toward socially necessary activities. His work then becomes his hobby; work becomes play; the right man is in the right place, etc. For every individual it is theoretically possible to balance the innate and acquired components in such a way so as to secure an optimum ratio which will produce a maximum variety in his behavior and a maximum of co-operative effectiveness.

Happiness

An attempt to define happiness in terms of the behavioristic postulates, seems at first, to be contrary to the fundamental assumptions of behaviorism. However, the term is to be used only in an objective sense and refers to the fact that there are certain combinations of responses which exhibit a degree of unity in variety that may be designated as

an optimum relationship between the innate-acquired components in the behavior life-history of every individual.

Cosmical evolution seems to be in the direction of greater complexity and larger aggregates in electron-proton organization and we should expect that any condition which in the long run, favors organized variability will survive over conditions which limit it.

Through language the temporal and spatial range of the sense organs is increased; industry, machinery, power, sanitation, have removed many of the limitations against variety in behavior. However, the very conditions which remove some limitations, impose others. But the new limitations increase the co-operation between individuals and thus develop a unity in group behavior which ultimately extends the range of individual variability. Tradition, custom, education, economic status, form stimulating conditions which produce a hierarchy of responses which are relatively constant for races or nations but the variability of the individual presents so many unknown factors that it is practically impossible to predict the extent to which these factors will contribute toward the optimum unity-variety ratio of a specific individual at a given time. In fact under our present highly civilized and specialized system, the life of an unskilled laborer may

represent a degree of unity which is drudgery and the satiated boredom of the idle may be only a lack of preparation for developing the degree of unity necessary for extending the variety in behavior under the given social conditions. Variety in behavior is a product of what we have designated as the innate components; unity in behavior results from the acquired components. According as the one or the other predominates there emerge the two antagonistic processes of (a) individualization and (b) socialization. There is however for each individual, at any given moment, an optimum condition in which the antagonism is least and when the total activity from the birth to the death of the individual is considered it is theoretically possible to designate a life optimum although at any given moment, and especially for such periods as youth, maturity, and senescence, the degree of antagonism between individualization and socialization may vary widely from the life-time optimum.

By clearly recognizing that civilization represents an ever widening circle of opportunities for establishing an optimum relationship between the innate and acquired components in the behavior of the individual and that the determination of this optimum relationship is an experimental and scientific problem of the same sort as a problem in medicine, the conception of human happiness can be given

a biosocial significance which is relatively independent of the ethical and moral standards which vary so much from country to country and from decade to decade. Neurologically the word happiness indicates the extent to which the innate and acquired components of sensori-motor function approach an optimum relationship between the antagonistic processes of individualization and socialization so that the movements of the individual are contributing directly or indirectly to larger or more complex electron-proton aggregates or larger and more complex social organization.

Man's Supernatural Destiny

Under a teleological interpretation of history, man was regarded as a being that was controlled by inner and outer forces which were relatively independent of what we now regard as physical forces. It was not a question of mere complexity but of an entirely non-physical order. From the standpoint of behaviorism the origin of these super-natural or religious conceptions of man's destiny, is a mathematical function of the biosocial conditions of the times. Religious beliefs and rituals are only stimulating devices through which a greater degree of co-operation between individuals is developed and they are effective as stimuli only until the myth upon which the rituals are based is replaced by some

theory which can be more or less successfully stated in terms of measurable uniformities. This replacement is conditioned by the development of science, and it is only as scientific principles become biosocial stimulating conditions for the mass of mankind, that the supernatural conception of man's destiny will be replaced by an experimental and scientific system of morality and rules of conduct. The fundamentalist-modernist controversy in theology is merely an articulate manifestation of changes that are occurring in the conception of man's ultimate destiny.

Man's Biosocial Destiny

As a larger percentage of the population begins to see that human achievement need not be regarded as the product of unanalyzable components based upon magical or mythical principles, there is gradually developing a biosocial analysis of human behavior which assumes a uniformitarianism between successive historical periods which is of the same order as that of the geological or biological record. The biosocial as opposed to the supernatural conception of man's destiny assumes electrons and protons as the ultimate elements from which the more complex inorganic atoms, molecules, crystals, are formed. Greater complexity is found in the organic molecules which reach one limit in the protoplasmic cell and a second limit in the large multicellular herbiv-

ora. Social organization represents the greatest degree of complexity and begins in the animal series as those relationships which are designated as parasitism and symbiosis, and in man these processes take the form of what is known as exploitation and cooperation. Social evolution as a *cosmical* process is producing larger and more complex electron-proton aggregates and as an *individual* process is developing a social organization that yields to each individual a maximum of variety in behavior. The ultimate realization of these conditions will produce a social organization and a type of individual that have as upper limits those properties best described as omnipresent, omniscient, and omnipotent, and from the biological side those properties which produce a maximum degree of interchangeability of the receptor-effector functions between individuals. From a statistical analysis of the conduct of individuals and groups, hypothetical behavior life histories and behavior types are being developed and incorporated into our educational system as stimuli for the modification of the conduct of the present generation. From the scientific record, man's destiny seems to be a biosocial destiny. What he does depends on the type of nervous system he has inherited and the social environment into which he was born. Today's behavior is the result of yesterday's actions and the cause of tomorrow's behav-

ior. Individuals are forming groups, groups are forming federations, states, nations, and alliances, and social evolution is well along toward a league of all the nations.

The final stage in which all peoples on earth will be united through some organization may be a long way off, but it seems to be inevitable. Man's destiny seems to be the achievement of conditions that represent an optimum relationship between unity and variety in his behavior. The character of this relationship is a scientific, not a teleological problem.

THE PROBLEM OF BEHAVIORISM

CHAPTER VI

THE PROBLEM OF BEHAVIORISM

DEFINITION: *The Stimulating Conditions, The Sensory-Cerebro-Motor Conditions, The Behavior Conditions*—THE SOCIAL STATUS: *The Specific Behavior, The Behavior Rank*—THE SYSTEMATIC STATUS OF BEHAVIORISM — PHYSICAL CAUSATION — PSYCHICAL CAUSATION: *Psychophysical Parallelism, Psychophysical Interaction, Monodualism*—THE DIFFERENTIA OF BEHAVIORISM—THE HUMAN RESPONSE DEFINED.

In this chapter only the general relationships between the parts of a human behavior problem are indicated. The details will be taken up under special headings. While behaviorism assumes an unbroken continuity between animal and human activity, the development of categories applicable to both is a special problem beyond the scope of this book.

DEFINITION

From the standpoint of the writer, behaviorism is the science that studies the origin and development of those bodily movements (responses) of the individual which establish his status in the social organization of which he is a member. The three parts of the problem are: (1) the stimulating conditions, (2) the sensory-cerebro-motor conditions, (3)

the behavior conditions, as measured by both the biophysical and biosocial responses.

The Stimulating Conditions.—These may be as simple as that of a loud sound, or as complex as that of an archeological record. The process of stimulation is to be regarded as the condition in which the metabolic rate of a receptor or group of receptors is accelerated to such an extent that an implicit or an overt contractile effect is produced in an effector. In their simplest form stimuli are classified as light waves, sound waves, movements, durations, temperatures, vapors, solids, liquids, gases, and in combination they form the physical and chemical properties. In their complex forms stimuli form the objects, situations, and events; and the records of the objects, situations, and events, which form or have formed the environment.

The Sensory-Cerebro-Motor Conditions.—These are to be regarded in the strictly neurological sense as including a study of the sensory mechanism, the so-called cerebral integrating mechanism, the central peripheral and autonomic nervous system, and the motor mechanism. From a study of these structures and their functions the behaviorist learns the limitations that are imposed upon the types of behavior that may or may not be formed.

The Behavior Conditions.—These are made up of the movements (responses) of the body or parts

of the body that directly or indirectly establish the social status of the individual. Two forms of responses are differentiated: (a) the biophysical responses which are analyzable into physical, anatomical, and physiological components, (b) the biosocial responses which are analyzable into ontogenetic, phylogenetic, and social components.

Thus as biophysical responses the words *today*, *aujourd'hui*, *heute*, either as sounds, as written or printed symbols, or as short-hand or telegraph code, are physically incommensurate, but as biosocial stimuli they are identical for all individuals who read English, French, and German in these forms. On the other hand, as stimuli for individuals speaking only one of the languages the three words are biosocially dissimilar.

Two responses (as stimuli for others) may thus be biophysically incommensurate, but biosocially equivalent; or they may be biophysically equivalent but biosocially dissimilar.

The Social Status

The concept "social status" that occurs in the definition of behaviorism is to be thought of as the product of two factors: the specific behavior and the behavior rank.

The Specific Behavior.—According to this factor behavior may be classified as educational, adminis-

trative, vocational, recreational, and personal. Each of these activities may again be divided and subdivided into special categories. The educational activities may be characterized by the main types of educational institutions as elementary school, high school, university, business college, or into the different curricular classifications as history, mathematics, mechanics, botany, chemistry, psychology, language, etc.; the administrative activities would include the types of behavior represented by the various social and civic duties; the vocational activities may be divided into the many trades and numerous professions; the recreational activities into the sports, clubs, art, music, and other forms of recreation; the personal activities into those forms of behavior which differentiate an individual from other individuals of the same group, as musical, artistic, generous, thrifty, emotional, and such physical properties as influence the social status.

The Behavior Rank.—Not only does behavior vary with respect to the type of movement, but it also varies with respect to skill and effectiveness within its own specific category. Under present social conditions the behavior rank is indicated in various ways: opinion, school grade, percentile, expert, journeyman, novice, salary, reputation, etc. The measure of the social status is the co-operative effectiveness of the individual in the social organi-

zation as expressed biologically by the degree of sensori-motor interchangeability.

The Systematic Status of Behaviorism

The systematic status of behaviorism as a science is that of a connecting link between the natural and the social sciences. Its subject matter is the study of the interactions between individuals anatomically independent, but functionally related to each other through their movements in such a way as to produce the sensori-motor interchangeability between individuals which socially is designated as co-operation.

The term behaviorism as now used represents so many different points of view, and these will change so frequently during the next decade that the word "behaviorism" will hardly survive. The term "praxiology" which was proposed by Knight Dunlap seems very appropriate although an attempt to assign a specific subject-matter to it at this time is probably premature. For the writer behaviorism represents, as it does for many others, a protest against all attempts to explain human achievement by the introduction of an element which is beyond the range of physical measurement. I believe that human achievement is of the same order as the inorganic and organic processes which prevail

in the physico-chemical universe, but since the extreme diversity of human achievement as represented in social organization, the sciences and the arts, surrounds all attempts at analysis with a controversial atmosphere, the term "behaviorism" is as good a term as any until a greater degree of uniformity has been reached.

There are two types of postulates according to which human behavior and human achievement may be explained: (1) Physical causation, according to which human achievement is the product of nothing but the physical processes and structures which make up the body and the environment, and in which the sole datum of existence is the electron-proton totality. (2) Psychical causation, according to which human achievement is the product of some entity which is not completely describable under the electron-proton assumptions.

Physical Causation

On this basis human behavior, human conduct, human achievement, human personality, are regarded as belonging to the same phenomenological categories as those which now form the subject of physics, chemistry, biology, in their strictly mechanical interpretations, excluding such conceptions as are made the basis of various systems of "vitalism." At pres-

ent this is most comprehensively expressed by the assumption that the universe is the totality of the electron-proton systems in it. Scientific development may require a modification of the electron-proton conception, just as it has modified the "indivisible atom" hypothesis.

Psychical Causation

On this basis, human behavior and especially so-called intelligent human behavior, results directly or indirectly from the operation of some non-material, imponderable force or agent, not included in the electron-proton hypothesis. At first these agents were personified as supernatural agents more or less similar to man himself. There were wide differences in the characterization of these agents, ranging from a mortal individual with supernatural power, to a non-personified supernatural force or entity. Whatever the nature of these agents their activities were not representable by the physical or mathematical system of science. Animistic beliefs or animism is the technical characterization of this form of causation.

Just as the physical conception of causation has passed through a series of stages beginning with the earth, air, fire, water (elements of Empedocles) down to the modern electron-proton hypothesis, so the psychical conception is no longer the spiritism

or supernaturalism of primitive man, but is now represented by such entities as mind, consciousness, the ego, vital forces, etc.

It is beyond the scope of this book to consider all the nuances that might be developed and have been developed by assigning variable potencies to the two types of causation (physical and psychical). Between the extremes of physical causation on the one hand and psychical causation on the other, there are found a number of intermediate types which partake of the nature of both systems.

Psychophysical Parallelism.—This hypothesis assumes the existence of a psychical (mental) series correlated with, but independent of, a physical (physiological) series.

Psychophysical Interaction.—This system postulates the existence of both forms of causation, not merely as correlated but as causally interacting, in the sense that psychical forces may initiate physiological changes and that the physiological changes may initiate psychical changes.

Monodualism.—In this system it is assumed that there is a third form of existential stuff or datum of which the psychical and the physical are mutually independent but correlated aspects or systems of properties.

The Differentia of Behaviorism

The innovations in behaviorism as I see them are:

(a) The repudiation of causal factors in human behavior that are not accepted by the natural sciences.

(b) The identification of human behavior with human achievement, and regarding human achievement as a form of motion.

(c) As a form of motion the human response may be the *effect* of antecedent responses or the *cause* of subsequent responses (in others) and that in this sense it may function as either stimulus or reaction.

(d) Cosmical development is an ever increasing complexity in the geometrical and symmetrical configurations of the electron-proton aggregates, and social organization constitutes one stage in this developmental series.

The efforts of behaviorists are directed towards establishing a generally acceptable physico-chemical account of the biophysical and biosocial conditions underlying man's origin and of his individual and social achievements. These achievements are assumed to be adequately expressed by the social organization and the social institutions that have been developed.

All forms of social activity or achievement are ultimately reducible to electron-proton interactions that are just as mechanistic as any physical or chemical process. The essential characteristics of the social category are: (a) the neuro-muscular character of a response is relatively unimportant as compared with its effect as a stimulus for other individuals; (b) the physical units of measurements as represented by calories, watts, foot-pounds, etc., are relatively inadequate to measure this stimulating effect; (c) the individual is classified not on the basis of physical or physiological properties but on the basis of his co-operative status in the social organization of which he is a unit.

The Human Response Defined

I have described the individual as a specific system of anatomical and physiological elements to be regarded as a locus in the electron-proton movement continuum, interacting with other loci and with the rest of the continuum. These interactions which are themselves movements fall into the three classes which in the biological sciences are known as the life processes: (a) nutrition and growth, (b) reproduction, (c) adjustment to environment.

The specific subject-matter of the behaviorist is represented by the movements that make up the adjustment to the environment (especially the so-

cial environment) and the element of these adjustment processes is the *human response.* Anticipating the more detailed analyses which are to follow we may set up the following definitions:

I. A response is a unified group of contractile effects which as movements form the basis of the co-operative, receptor-effector (sensori-motor) interchanges between individuals. (The response begins with the chemical change in the receptor, and ends with the contractile effects).

II. Human behavior is the totality of the response systems that establish the individual's status in the social organization of which he is a member.

Under human behavior are included the so-called educational, vocational, administrative, recreational, and personal activities of the individual. These activities are the antecedents of social organization and of social institutions.

Human responses conform to the strictly physical or mechanistic causal categories and exclude non-biological or psychical factors. Three relatively independent classes of responses may be established: (a) the biophysical responses which represent the terminus of the strictly biological sciences in which the sensori-motor functions of man are studied as anatomico-physiological phenomena. (b) The implicit responses which represent the obscure sensori-motor functions that occur within the body of the in-

dividual and to which he alone can react discriminatively. (c) The biosocial or overt responses which represent the beginning or the fundamental basis of the social sciences in which the individual is regarded as an element in a social organization and in which his responses are classified with respect to their cooperative effectiveness in producing a given social organization. These classes will be described in detail in subsequent chapters.

PART TWO

THE ANALYSIS OF HUMAN BEHAVIOR

THE HUMAN RESPONSE

CHAPTER VII

THE HUMAN RESPONSE

Inherited and Acquired Factors—Biological and Social Factors—The Difference Between Man and Animal.

Inherited and Acquired Factors

The extent to which there are at birth and during growth actually preformed (inherited) sensori-motor pathways of relatively low resistance is a matter of considerable controversy. The question hinges largely upon what is to be included under the term inheritance. That sensori-motor arcs are actually present as unit characters in the fertilized ovum does not seem to be held by any one. As embryological development proceeds the nervous system is differentiated into its various anatomical structures. How much the order and rate of growth of the nervous system depends upon germinal factors and how much is due to the pressures and chemical conditions of adjacent embryological tissues has not been determined. However, as intra-uterine growth proceeds the interaction between adjacent pressures, local chemical conditions, the nutritive and mechanical conditions are much more uniform from individual to individual than they are after birth and as a result, infants are born with a

relatively uniform constitution. The sensori-motor arcs that form a part of the vegetative processes such as ingestion, circulation, respiration, do not become functionally important until a considerable time after they have started, apparently as a reaction to adjacent mechanical and chemical conditions. With respect to human behavior any attempt to calculate separately the germinal, somatic and environmental effects becomes a matter of statistical analysis. If every ten-day old infant winks his eyes when a sound of a given intensity acts upon his ears, we must assume that a connection between the auditory receptors and the muscles of the eye-lids exists. It may, of course, not be a germinal property at all. It may be due to the fact that while the otic vescicles are differentiating the growing axons of the acoustic nerve are forced by purely mechanical and chemical conditions in the adjacent embryological structures into the region of the muscle tissues which later become the palpebral muscles. If, however, this condition is relatively uniform for all infants of a given age we may characterize it as an inherited reflex.

Without entering into a comprehensive discussion on the criteria for inheritance, we find in the facts of family resemblances, racial resemblances, individual differences, etc., a justification for the Mendelian conception of inheritance. The problem of

the number and the character of instincts and reflexes becomes acute only when instincts are regarded as faculties which control behavior. For the behaviorist the problem of instincts is one of determining the genetic antecedents of those movements which establish the social status of the individual. This is an experimental and a statistical problem and until there is available a more complete classification of the types of sensori-motor connections than we now possess, it will be necessary to use such terms as reflexes, instincts, habits, innate, acquired, etc. Furthermore, the specific and quantitative character of the Mendelian conception of inheritance commends itself to the behaviorist as the best theory upon which to build an experimental program designed to determine to what extent the acquisition of new forms of behavior is conditioned by germinal and somatic factors.

Biological and Social Factors

If it were possible to present a continuous moving picture of an individual culturally and anthropologically entirely dissimilar from us, moving in an environment entirely fantastic and different, the behavior of such an individual would seem to us to be a series of random and unco-ordinated movements until a classification which grouped the stimulating and the effector conditions in relation to each other

or to the social order that prevailed, had been worked out.

Our own behavior is of the same character and it is important to realize that human responses are arbitrary segments lifted out of a behavior continuum. If instead of eyes we had receptors for electro-magnetic waves and if our effectors or muscles when stimulated flashed forth electro-magnetic disturbances instead of contracting, our observations, our literature, our science, our philosophy (supposing some equivalents had been developed) would be of a different order than they now are. The human response is biologically a series of neural connections between sensory and motor points. These connections are modified almost as soon as they appear, in the direction of a socially standardized system of movements.

The fundamental forms of movement which underlie all behavior are given by Max F. Meyer ('21) in the following eight classes: "(1) Locomotion in a straight line in response to lack of food. (2) Turning the body axis sidewise in response to an obstacle. (3) Positive localization. (4) Negative localization. (5) Grasping. (6) Adjustment of the sense organs. (7) Signaling. (8) Sleeping." (p. 210). These include both human and animal behavior. If this list is provisionally accepted then the development of behavior is in reality the pro-

cess of changing the neural interconnections between the sensory and motor points involved in these fundamental forms of behavior into the adult type of connections.

The human response is defined in social terms to exclude the vegetative, nutritional, regulatory, and reproductive processes insofar as they do not contribute toward establishing the social status of the individual in the group of which he is a member. The differentiation between the biological and the social factors may be made clearer by the following illustration: Consider an individual whose contractile effectors are completely paralyzed but in whom all other sensori-motor processes are intact. His sense organs are being stimulated, his neurons are conducting nervous processes, the glands are secreting, but no muscle fibers are contracting. To what extent is this individual (who is absolutely motionless) responding? From the social standpoint such an "effectorless" individual would be reported as "responseless" or as virtually dead. From the biological standpoint, assuming perfect physical analysis, the report would be, "Complete anesthesia." Suppose the behaviorist himself is the "effectorless" individual. His report would be,—"oblivion."

We may affirm that other possibilities exist and provide a category such as mind or consciousness, and to develop such a phrase as *no psychosis without*

a neurosis, but is it not simpler to substitute the platitude, *without movement there is oblivion*, or in its tautological form, *without movement there is no movement.* For the behaviorist life, action, and the so-called psychical conditions can only be adequately studied as movements (in contractile elements) of such magnitude that they may act as stimuli and release responses in others. This means that a response whether biophysical or biosocial can only be a series of movements of some part of the body which results from the functioning of contractile elements having no other than anatomical, physiological, physical, and chemical properties. The so-called psychical phenomena are merely names that refer to movements so obscure and vague that they cannot be localized and specifically discriminated as effector processes.

Biophysically all responses exhibit motion, direction, extent, velocity, magnitude, complexity. Biosocially all responses exhibit stimulating effects that establish the individual's social status. The biophysical properties are independent of the biosocial properties of a response. The movements in lighting a match on two successive occasions may be biophysically similar, but if in one case the movements ignite a cigar and in another, start an incendiary conflagration, from the social standpoint, the two responses are entirely different. A differentiation

of behavior into biological and social factors is thus merely a recognition of the fact that a response may be analyzed either into its anatomico-physiological elements, or it may be analyzed with respect to its stimulating effects on others.

The Difference Between Man and Animal

It is particularly in man that social evolution finds its greatest complexity, but the processes of evolution have had their origins in the infra-human species. In establishing man's biological relationships to the animals, the emphasis upon his anatomical and physiological similarities to them has tended to obscure his enormously greater dissimilarities as shown by his co-operative activities. In the past, this co-operation was merely the organized exploitation of one group by another. This is still largely the case but seems to be a temporary development of the parasite principle which already is being replaced by a form of international organization much more inclusive than the racial, national, or class groupings, that now exist. The abrupt step from the most complex animal organization to man's railroads, banks, poison gas, Red Cross, League of Nations, gives such obvious support to those theories in which man is regarded as a special creative act of some super-being or force, that the acceptance of a

purely mechanistic or biological explanation of human conduct will be contested most by those investigators who have studied man's *achievements* rather than the mechanisms underlying these achievements.

Man as an anthropological and ethnic unit has been much studied but this study has been based upon at least an implicit assumption that ethnic principles were in some way super-biological and that an analysis of an ethnic group's culture could only be carried out on the assumption of hypothetical mental or psychical elements. From the behaviorist point of view these ethnic processes merely represent those bodily movements that ultimately are significant as stimuli for other individuals and that with respect to neuromuscular complexity they need show very little correlation with the ethnic status. The biosocial response which, if of relatively small importance in animal behavior, is the characteristic human response, not because man is not an animal but because he is the animal that has evolved the principle of receptor-effector interchangeability to the greatest degree. Through his language responses the individual has become an integral part of a system of conditions which extend his environment virtually without limit as to space and time. An animal on the other hand can react only to the immediate environmental conditions during its life and only within the spatial range of its own sense organs.

Most human responses have been acquired and represent interactions between the inherited sensori-motor arcs to form the new combinations known as habits.

Practically all the reaction systems with which the behaviorist is concerned are habits. Human reactions may be illustrated by the following types: Oral, written, and printed language reactions; representative movements as in drawing, gesture, pantomime, photographs, signals; discriminatory reactions between right and left, light and dark, heavy and light, weak and strong, same and different, up and down, true and false, near and far; serial reactions as in counting, calculating, planning, organizing; periodic reactions as those forming a diurnal, weekly, monthly, yearly, or other temporal cycle; rhythmical reactions as in dancing, marching, singing, playing a musical instrument, poetry, certain kinds of work. The social aspect of human behavior is merely a reclassification of the effector conditions in conformity with their co-operative significance in social organization.

No such classification of the movements of animals can be made because animals have no social organizations which are based upon the same principles that underlie the more complex human responses that have been enumerated.

The analysis of human behavior in addition to the inherited, acquired, anatomical, and physiological

factors, introduces a social factor which requires a reclassification of behavior into what has been designated as biophysical and biosocial responses.

THE BIOPHYSICAL RESPONSES

CHAPTER VIII

THE BIOPHYSICAL RESPONSES

ANATOMICAL ELEMENTS

SENSE ORGANS OR RECEPTORS—THE NEURON: *Sensory or Afferent Neurons, Connecting Neurons or Association Fibers, Motor or Efferent Neurons*—MOTOR ORGANS OR EFFECTORS—THE SYNAPSE—THE SENSORI-MOTOR ARC—THE ARCHITECTURE OF THE NERVOUS SYSTEM.

The biophysical response is the functioning of the sensory-cerebro-motor structures. The investigation of these structures and their function is primarily the work of the neurologist, but in so far as the behaviorist is concerned with the ontogenetic or phylogenetic development of the various forms of behavior he must know how behavior is conditioned by the properties of the neural mechanism.

There is gradually being established a reciprocal rather than an antagonistic relationship between the neurologist and the student of human behavior. Many of the properties of the nervous system cannot be directly derived from the post mortem technique of the neurologist, and on the other hand when the behaviorist tries to explain his own facts without adequate neurological insight he is disposed to develop a hypothetical neurology, based on the simplest assumptions necessary to explain the facts. To

the neurologist these assumptions often do not seem warranted from the consideration of such morphological and physiological facts as are available. This has developed much controversy in the past and perhaps has not resulted in the most effective co-operation. The study of the properties of the sensory-cerebro-motor system in its relation to the behavior achievements of the individual is establishing more sympathetic co-operation between anatomists, neurologists, physiologists, psychologists and the behaviorists. What follows should be regarded as only a very schematic attempt at describing the neural elements in behavior.

Sense Organs or Receptors

The sense organs are specialized cells which are variously distributed over and within the body and include such elements as the rods and cones in the retina; hair cells in the cochlea, semi-circular canals, utriculus and saculus; various types of cells sensitive to warm, cold, pressure, pain, in the cutaneous surfaces; taste cells in the mucous membrane of the tongue; spindle cells in the olfactory mucous membrane; as yet undifferentiated kinesthetic receptors in muscles, joints, and tendons; undifferentiated organic receptors in the mucous lining of the viscera and internal structures within the body cavities. The sense organs or receptors are the *sensitive* structures

through which the body is placed in functional relationship with those external and internal conditions which maintain the metabolic level of the organism as a whole, and with respect to movement establish a correlation between bodily movements and the environmental conditions.

The Neuron

From the anatomical standpoint nerve cells present a great variety of shapes and sizes, depending on their location and the nature of the *conducting* functions that they perform. Without attempting to describe the various morphological types, a neuron is a single nerve cell composed of dendrites, one or more axis cylinders or axons, a cell-body with its nuclear and cytoplasmic structures, collateral branches, neuro-fibrils, endbrush, synaptic connections with other neurons. For different neurons the prominence of these parts vary within wide limits. From the behavior standpoint, the neurons fall into three main types: sensory, connecting, motor. These terms refer to functional rather than histological differentiations.

Sensory or Afferent Neurons—The dendrites of the sensory neuron terminate in or adjacent to a sense organ or sensory mechanism; the end-brush terminates in a synaptic connection which either represents the beginning of the central nervous sys-

tem or a step toward it. In the simplest neural mechanism the sensory neuron seems to form a synapse with a motor neuron without an intermediate connecting neuron. In other cases the sensory interconnections become very complex. In the retina of the eye for instance, there already exists a very complicated system of neural interconnections, which histologically exhibit a degree of complexity which is hardly duplicated in the cortex of the brain.

Connecting Neurons or Association Fibers—These neurons serve as a bridge between sensory and motor neurons. They form the bulk of the central nervous system, and of the autonomic system not composed of motor neurons. The synaptic connections between sensory and motor neurons are the structural elements through which the interconnections between receptors and effectors are established.

Motor or Efferent Neurons—In the typical motor neuron the endbrush terminates in muscle fibers or gland cells. The dendrites terminate in synapses which represent the motor limits of the connecting neurons in the central or autonomic systems. In some of the so-called spinal reflexes the sensory neuron may end in the beginning of the motor neuron.

Motor Organs or Effectors

These are the contractile or secretory structures that function in behavior. The histological element

is the muscle fiber and the gland cell. The muscle fibers fall into three main groups: striped or skeletal muscle (the most important for human behavior), cardiac muscle, and smooth muscle. The gland cells make up the secretory structures of the body such as the thyroids, supra-renal glands, pituitary body, sex glands, pancreas, and others. The secretions when introduced into the blood stream act in such a manner as to modify the excitability of either the nervous system or the muscles and in this way condition the behavior of the individual.

The Synapse

When neurons are connected to form a chain of neurons, the point at which the connections are made is called a synapse. Many investigators attach great importance to these synaptic connections and regard them as structures which determine the neural resistance, the rate of propagation of the nervous process, the functional direction of the propagation, and a resonating property which acts selectively on a nervous process which may originate as a complex of a number of vibratory frequencies.

The Sensori-Motor Arc

This is a hypothetical structure (the unit of physiological function) composed of a sense organ, a sensory neuron, a connecting neuron, a motor neuron,

and a motor or secretory organ. Its simplest form is that of a reflex arc made up of inherited paths of low resistance between relatively few sensory and motor organs, and grading imperceptibly in complexity to the most recently acquired and most complicated behavior, involving hundreds of sense organs; hundreds of sensory, connecting, and motor neurons; and hundreds of motor organs.

The Architecture of the Nervous System

From the standpoint of morphology, the human nervous system is an exceedingly complex structure made up of a peripheral system which includes the sense organs and motor organs with their connections; a central nervous system made up of the brain and spinal cord; and the autonomic system with its various plexuses. Many so-called neural paths between sense organs and motor organs have been traced through the various nerve centers and nuclei that are distributed in the cerebrum, thalami, cerebellum, medulla, and in certain regions of the spinal cord.

For behaviorists the nervous system is a structure through which sense organs and motor organs are interconnected with each other in many different patterns to form various sensori-motor arcs. The plan of the interconnections, according to Max Meyer

('11) is that of a hierarchy of levels. Hypothetically every sense organ is connected with every motor organ through connecting neurons, but the number of the connecting neurons varies from zero in the case of a spinal reflex to an unanalyzable complexity of interconnections in the cortical centers. Meyer regards the nervous system as superimposed sensory motor arcs, each superposition representing a higher level. Through the lower levels of connecting neurons only relatively few sense organs and motor organs are interconnected, each higher level increasing the number until the hypothetical condition is reached in which every sense organ is regarded as connected with every effector through variable degrees of neural resistance.

PHYSIOLOGICAL PROCESSES

The Sensory Process—The Nervous Process—The Motor Process—Neural Resistance—The Resistance Gradient.

Every action that an individual performs is the result of sensori-motor processes. Of these there are three types: sensory, nervous, and motor processes. Whether the action is that of withdrawing the finger from the hot stove or the myriad of movements which are involved in the recording of a finished sonata, physiology can detect only sensori-

motor processes as the direct antecedents of these movements.

The Sensory Process

This process is initiated by one of the physical or chemical conditions known as a stimulus or a stimulating condition. When a receptor has been adequately stimulated a chemical or physical change takes place in the receptor. Very little is known as to the nature of this process, but from the work of Hyman and Bellamy ('22) on metabolic gradients, stimulation seems to be an acceleration of the metabolic rate of the sense organs. In the rods and cones of the retina the process seems to be of a chemical or electrical nature similar or identical with what is known as the formation and propagation of ions. Whatever may be the physico-chemical nature of the sensory process, it is the antecedent of the nervous process.

The Nervous Process

This is another physical or chemical change which is initiated by the sensory process, is propagated over the sensory, connecting and motor neurons and is the antecedent for the contraction or the secretion in an effector. Much confusion exists from the fact that the nervous process is given different names such as nervous impulse, excitation, etc. One may also still find such phrases as *the stimulus or sensation passing over the nerve.* According to R. S.

Lillie ('22) the nervous process may be regarded as a bio-electric process which is propagated along the nerve.

The Motor Process

When a nervous process of sufficient strength reaches the muscle fibers these contract and shorten, thus producing movement in the structures which enclose the fibers. In case the nervous process reaches a gland cell a secretion characteristic of the gland is released into the blood stream or duct.

Neural Resistance

It is assumed that a nervous process that is passing over a sensori-motor arc encounters resistance against its passage, either through the neuron or its synaptic connections. This resistance may be great or small and it determines the proportion of the original sensory flow or flux which will reach the various motor outlets of the sensori-motor arc. In general we may say that the resistance of a sensori-motor arc decreases with function up to a certain limit, and with lack of function the resistance asymptotically approaches its original value. The conception of resistance as a property of neurons has been criticized. For the behaviorist the term implies only that any given movement is not constant with respect to speed, accuracy, or the stimulating conditions under which it occurs.

The Resistance Gradient

This is a quantitative conception of the relative resistance (or the relative conductivities) between given sense organs and given motor organs in the various branches of a sensori-motor arc. A change in the resistance gradient is assumed when a response changes under relatively constant stimulating conditions, as in learning typewriting for instance. At any given instant the conductivity between all the sense organs and all the motor organs of an individual may be regarded as possessing a numerical value. The enumeration of these values would represent the resistance gradient of the individual at this instant. At some other time the enumeration of the conductivity between all the sense organs and all the motor organs, would show different values and this would be described as a change in the resistance gradient. The conception may, of course, be applied to partial systems. Thus the process of learning a particular act as typewriting can be regarded quantitatively as a gradual change in the resistance gradient between the sense organs and motor organs of the typewriting activity.

THE BIOPHYSICAL MECHANISMS

THE SENSORY ACCOMMODATORY AND POSTURAL MECHANISM—THE ORGANIC REGULATING MECHANISM—THE TONICITY MECHANISM—THE INHERITED MECHANISM—THE BODILY RESPONSE MECHANISM—CEREBRATION: *Variability of Interconnections, Resistance and Function, Resistance and Synaptic Level, Interaction Between Nervous Processes, Distribution of Nervous Flux, Sensory Reduction, Endocrine Secretions, Inherited Variations*—THE CEREBRAL MECHANISM—CENTRAL OR CEREBRAL INTEGRATION—GENERAL.

All of man's achievements are merely the totality of his behavior, and all behavior it is assumed, may ultimately be reduced to the functioning of the contractile elements within the body. When a receptor has been adequately stimulated, a nervous process is initiated, is propagated over the nerve fiber, then over a nerve trunk to the brain where it passes into a very complex system of neural interconnections and finally reaches many muscle fibers or gland cells. This is the general plan of the sensori-motor mechanism. The neural interconnections between receptors and effectors approach a condition in which every receptor may be regarded as connected with every effector, but not through equal degrees of resistance. To illustrate: Suppose a flash of light is used as a stimulus. The instructions to the subject are, "When you see the light flash, move your right hand; when it flashes again, move your left hand;

when it flashes again, say *red*," etc., varying the instructions until many different movements have been performed. Which set of muscles will contract at any given light flash will depend upon what verbal stimuli have preceded. When the auditory instructions change, the neural connections between the eye and the muscles also change, and it is clear that the retinal sensory elements (which it is assumed were the same for each light flash) in turn become common sensory elements in a large number of sensori-motor arcs. However, there are certain sensori-motor arcs which cannot be so readily established.

If the instructions are: "When the light flashes, hold your breath," this action can be started but not continued indefinitely. After a few minutes, the effects of the auditory stimulus *hold your breath* are replaced by the internal stimuli from the increased carbon dioxide content of the blood, and breathing is resumed. The auditory stimulus *hold your breath*, is at first strong enough to stop breathing but the carbon-dioxide stimulus gradually becomes stronger until it releases the breathing reaction even though the auditory stimulus is still acting on antagonistic muscles.

Some sensori-motor arcs between the eye and certain muscles cannot even be started. For instance, no sensori-motor arc to the instructions, "When the light flashes stop your heart beat," can be established.

This, of course, only means that neural connections between the eyes and the heart muscles which stop the heart cannot be established by *verbal* instructions of the type used, but that connections between the eyes and the heart actually exist, is demonstrated by the fact that when the individual looks down from a high building, the heart beat actually does change. We are not now concerned with the directness or indirectness with which these sensori-motor interconnections are established, but only with the fact that the stimulation of given sensory organs may release hundreds of responses, but not all of them with equal facility.

We have lliustrated so far that one stimulus, the flash of light, may release many different motor patterns. However, these same patterns may be released by the stimulation of other receptors. Thus instead of the flash of light we might have used an auditory click, a touch on the hand, an oral word signal, an odor, a taste, in fact hundreds of other stimuli. The further fact that this variety in the interconnections is established in a few years for human beings indicates that there is some underlying relatively simple plan of neural interconnections although the *morphological* complexity may defy analysis. The assumption, that every receptor is connected with every effector but through varying degrees of resistance, and that the number of different

sensori-motor arcs that may be established is practically unlimited, seems justied as a working hypothesis. The assumption carries the behavioristic implication that *different* stimuli may release the *same* response; or the *same* stimulus may release *different* responses.

When the individual responds to his environment the actual movements involved in the overt socially adequate reaction, represent only a small part of the actual adjustment that is taking place. The many preparatory movements, the posture of the body, the respiration rate, the circulation of the blood, the tonicity of the skeletal masculature, etc. are all factors in behavior. Under ordinary conditions these mechanisms are part of the total response through which the musculature is prepared to meet the energy conditions that are required under the environmental conditions surrounding the individual.

The Sensory Accommodatory and Postural Mechanism

When a nervous process from the sense organs enters the central nervous system, part of the nervous flux passes to those muscles which accommodate the sense organs and produce a bodily posture which increases the effectiveness of the particular stimulating conditions. For instance, a sound stimulus act-

ing on the ear releases nervous processes part of which go to the muscles of the eyes, neck, shoulders, trunk, and legs, so that the head and body are brought into such a position that the source of the sound is localized in space. When the effectors of the accommodatory mechanism function, there is a stimulation of adjacent kinesthetic and perhaps organic receptors. Just what becomes of these secondary processes is not known. On the assumption that they must reach some effectors, or at least supplement the neural flux that is going to some effectors, it is probable that they function as a sort of "fine adjustment" for the accommodatory effectors. The so-called integrative action of the central nervous system may be partly due to the reciprocal stimulation between the various phases of the accommodatory processes and the afferent processes which release the overt responses. Some idea of the integrative actions of these accommodatory processes may be derived from a consideration of the amount of modification that occurs in the unused member of a bilateral system, such as the amount of skill acquired by the left hand when only the right hand has been used, e. g., in learning to write. No attempt will be made to describe the many different types of accommodatory adjustments. The largest class is that of bodily posture which is practically continuous even in sleep.

The Organic Regulating Mechanism

Aside from any overt movements that the organism may be making there is a constant functioning of various sensori-motor arcs in the body which maintain the life processes of the organism at a given level. Among these sensori-motor functions may be mentioned: respiration, blood circulation, digestion, the release of reserve food materials into the blood stream to restore the nervous and muscular tissues as they are depleted of their energy liberating materials during function, vaso-motor adjustments, the function of the endocrine effectors in producing conditions that prepare the body for specific types of overt behavior, and a host of other sensori-motor processes which maintain a certain metabolic level between the various structures of the organism. It is practically impossible to localize the sense organs through which the organic adjustments are initiated. We know, for instance, that the stimulating conditions that release the rage reaction as overtly expressed, also release secretions into the blood stream that hasten coagulation, that increase the sugar concentration in the blood, that modify vaso-motor conditions, etc. The precise sensori-motor conditions by which these organic adjustments are secured is not known. We do know that they are modified by sensory processes from the periphery, as when a visual stimulus from an exceedingly dangerous situation

modifies respiration, changes vaso-motor compensation, changes the pulse rate, and initiates secretory activity, but the histological or anatomical conditions have not been isolated. While this effect of the peripheral stimuli upon the organic adjustments is most pronounced when the peripheral stimulus is strong, we must assume that the effect is roughly proportional to the intensity of the stimulating effects and that there is a constant interaction and reciprocal modification between the peripheral processes and the organic processes and that this interaction is one of the factors in the so-called integrative action of the central nervous system.

The Tonicity Mechanism

The mechanism by which the tonus of the muscles and the degree of tenseness of the bodily posture is maintained is practically unknown. Active adjustment increases or decreases the general rate and intensity at which all effectors will function. The variations of this adjustment range from the low irritability during sleep to the hyperirritability under alert wakefulness, excitement, or under the effects of such drugs as strychnine. Besides the special tonic reflexes there are other more obscure effector conditions which are designated by such terms as excitement, depression, and which interact with the sensori-motor conditions arising from

peripheral stimulating conditions. Thus an auditory stimulus *to take a walk* may lead to acceptance if the tonicity conditions are favorable, and refusal if the conditions are unfavorable, as after a hard day's work. Many of the so-called *moods* represent tonicity and peripheral sensory resultants. While the exact sensori-motor facts of the tonicity adjustments are not known, the behavioristic fact that they modify behavior and are one of the factors in the so-called integrative functions of the central nervous system is well demonstrated by the behavior of a mob or crowd.

The Inherited Mechanisms

These include the so-called reflexes, instincts; individual, family, or racial traits; and everything which may be included under the "innate" characteristics of the individual. A consideration of these factors in detail is beyond the scope of this chapter.

The Bodily Response Mechanism

This includes the sensori-motor connections and functions which represent movements, principally of the skeletal musculature through which the body assumes its temporal, spatial and mechanical relations to the environment, e. g., walking, handling objects, the speech movements in language, in fact all the movements through which the social status of the individual is established.

Cerebration

The preceding five biophysical mechanisms are all interconnected with varying degrees of functional intimacy and the observable motor effect at any given moment is always a resultant of (a) the nature of the stimulating conditions; (b) the interactions between the simultaneous functioning of the mechanisms; and (c) the residual effects of past functioning on the present structure of the mechanisms.

The modifications as they occur are the result of physiological conditions more or less independent of the mechanism itself but conditioning whatever sensory processes are occurring. It is not too much to say that even under the most favorable conditions two identical stimuli will never release identical reactions. The mere functioning of the nervous system changes its own resistance gradient. Under ordinary conditions the inherited reflexes are regarded as stable, yet even such a relatively constant sensorimotor condition as the knee-jerk has been shown by Tuttle ('24) to be modifiable by simple verbal instructions. The assumption that every nervous process that occurs changes the resistance gradient for all subsequent nervous processes, may seem an extreme statement, but it brings out the fact that there is no need for postulating other conditions than those that already exist, to account for the complexity of human behavior.

A few of the less specific conditions which modify nervous functioning will be mentioned although exact information as to the nature of this functioning is still to be acquired. As long as psychical or conscious factors were accepted as causal agents which arranged the proper sensori-motor connections, there was no need of studying the interaction of sensori-motor processes. The conscious or unconscious forces assumed full responsibility. When the preceding five mechanisms and the more general factors which follow are regarded as an interacting system, the assumption that the cerebral mechanism is only a name for the totality of these effects seems justified.

Variability of Interconnections—This has been discussed in some detail under the anatomical elements. In comparison with animal life, human reactions are more varied and this greater variability seems to be due to the fact that the human nervous system is so constructed that it presents a practically unlimited variety of potential connections between its receptors and its effectors.

Resistance and Function—Up to a certain limit the resistance of neurons or synapses decreases with the amount of function and proportionately to the magnitude of the function (learning, practice). With the cessation of function the resistance of the sensori-

motor arc tends to approach the original unmodified conditions (forgetting).

Resistance and Synaptic Level—The resistance through the higher neural levels changes more rapidly than through the lower levels. Complex habits such as the educational responses are more variable and less permanent than the routine forms of behavior such as eating, mode of dressing, etc. If the superimposed reflex arc type of neural interconnection developed by Max Meyer ('11) is accepted this greater modifiability of the higher levels is the result of the fact that the higher the level of the neuron, the greater the number of sensori-motor arcs of which it is an element, and the greater will be the probability that it will carry a larger part of the "general" neural flux which is at all times present.

Interaction between Nervous Processes—A strong nervous process will modify the distribution of all other weaker processes that are occurring with it. Under this heading may be included many of the so-called effects of "attention."

Distribution of Nervous Flux—Any nervous process originating in any sense organ is distributed to every motor organ, but the amount of flux is only strong enough to release function in relatively few effectors. These effectors have been connected

through paths of relatively low resistance either by inheritance or through past function. The constantly changing external and internal sources of stimulation interact and modify the effect of any frequently recurring or long continued stimulus so as to produce a constantly changing resistance gradient between receptors and effectors. In behavior this manifests itself as a continual change in the reaction pattern even though a given stimulating condition is relatively constant or uniform.

Sensory Reduction—With repeated function the number of receptors that may release a given reaction is decreased and in time the reaction may occur from the stimulation of entirely different receptors.

In learning to read, for instance, every letter must be fixated. After some practice the word as a whole without the fixation of a single letter may be sufficient. After skill in reading has been acquired a fixation of some point in every third word will release the proper pronunciation reactions. In case of frequent repetition the pronunciation may even occur without the original printed word stimulus, as when a passage has been memorized.

Endocrine Secretions—The available food material in the nerve cells and muscle cells is never great enough to support continuous function of the neural or contractile elements for long periods. The

reserve supply in the liver (glycogen) is not in a form to be immediately available. There is a constant regulation to maintain an optimum balance between available food, the muscular energy that is released, and the amount of stored food that must be converted before it can become available.

In the process of conversion the endocrine secretions form an important part in preparing the neuromuscular and vascular mechanism for the energy demands which will be released by the stimulating conditions.

Inherited Variations—Many of the interconnections between receptors and effectors that are established develop along specific lines if environmental conditions are favorable. A statistical analysis of the occurrence of such forms of behavior as artistic ability, mathematical ability, color blindness, feeblemindedness, etc., indicate that there are physiological limits beyond which the effect of the sensory stimulations are ineffective in modifying the behavior of some individuals. These limits are conditioned by the nature of the germ plasm and conform in their transmission from parent to offspring to the laws of inheritance. Speaking generally there is for every individual a series of stimulating conditions which are of maximum effectiveness in establishing a group of habits that represent the *best* adjustment between the individual and his environment. The limits

which the nature of the germ plasm imposes upon sensori-motor modifications represent the innate capacities of the individual.

The Cerebral Mechanism

This phase of the sensori-motor function begins with the synaptic ending of the sensory neurons and ends with the synaptic ending that marks the beginning of the motor or efferent neurons, passing through those connecting neurons or association fibers which are located in the cerebral hemispheres. The term cerebral is not to be used too literally. The cerebral mechanism is to be regarded as essentially a system of interconnecting fibers between all the receptors and all the effectors. A picture of what occurs in the cerebral mechanism at any given instant is best expressed by some numerical system which would represent the magnitude of the nervous processes occurring in all the neurons. It is to be regarded primarily as a conducting system, and if integrating functions are ascribed to it this does not mean that there are forces in addition to the ones already indicated which alter the conductivity of the neurons in conformity with some teleological principle. It is true that the resistance gradient of the connecting net-work is constantly changing but this is due to the physiological properties of the neurons and the synapses and whatever modifications occur

as the interaction of nervous processes. If for the moment we accept the law that the resistance of neurons or their synapses vary with the magnitude of the nervous flux that passes over them, we can readily see that the neural functional patterns *must* be constantly changing. If to this constant change we wish to give the name of the integrative action of the nervous system, there can be no objection so long as we do not introduce an integrative faculty or entity of some kind.

For the behaviorist the cerebral system is regarded as a net-work of interconnecting nerve fibers as described in the architecture of the nervous system. Functionally, it may be divided into a hierarchy of levels: the lowest level being that series of neural connections which connect the fewest number of receptors and effectors, the highest level being the series of neurons that connect the greatest number of receptors and effectors. Some of these levels are more or less specific and are called centers by the neurologist, but a center is not to be regarded as specific for different forms of behavior. For human behavior it is very probable that all parts of the brain are involved and that the localization at some particular brain area of such complex sensori-motor functions as we find human behavior to be, seems very doubtful. It does seem as if the interconnections between the neurons of the lower levels are

more stable and permanent than the interconnections between the higher levels. The actual neurons that are functioning between receptors and effectors depend upon the stimuli that are acting at the time. When a nervous process passes over a neuron or the synaptic connection between the neurons, some modification in the resistance occurs which changes the resistance gradient of the whole network. This property of modifiability varies with the individual and with the particular net-work that is functioning. The innate properties of the central nervous system determine the rate at which new sensori-motor connections are formed or the rate at which they disappear, but the behaviorist does not regard them as a selecting agent in the sense that other connections than those that actually are formed *might* have been formed. When it is considered that at any given instant the cerebral or central nervous system is carrying neural processes from sensori-motor adjustments that function in the accommodation of the sense organs, the posture of the body, in the tonicity of the various muscle systems, in the organic processes which release reserve energy for those muscle systems whose supply has become exhausted in the basal metabolic processes, and finally in the overt movements by which the organism adjusts the body to environmental conditions, and that all of these nervous processes must modify each other to a greater or less extent, we are

rather surprised that the uniformity in behavior is as great as we find it. The prevailing conception as to the relation between stimulus and the overt response is too simple. When the sensory process reaches the central nervous system it branches out into an exceedingly complicated net-work of conductors and is distributed to many auxiliary mechanisms which are not regarded usually as a part of the more spectacular overt response. The cerebral mechanism is not a mechanism in the sense that it is a specified system of sensori-motor connections or sensori-motor properties. It is merely the totality of the sensori-motor arcs and the interactions between the sensori-motor properties.

Central or Cerebral Integration

The extreme variability of responses, the morphological complexity of the brain, and the obscurity which surrounds the actual processes of retention, learning, selection, has given to the so-called cerebral mechanism a significance which, it seems to me, has hampered the development of a purely mechanistic explanation of human behavior. Warren ('14) for instance, argues that "the essential adjustment operations are central. Characteristic responses may be obtained *before* the implicit control responses are effective, in which case they would be determined solely by central conditions and by the nature of

stimuli. If this be true, then the central process, not the response, is the significant feature of neural activity" (p. 267). And in conclusion, "If, as is here contended, the central portion of the nervous arc is most significant in the process" (the interaction between environment and organism) "then the fundamental concern of psychology is with the operations of the central nervous system" (p. 269). It seems to me that this excludes any recognition of what I have designated as behavior equivalences, and makes of the central nervous system more than a mechanical component in sensori-motor function. Is it not simpler to assume that there are *no* central *control* or cerebral *integrating* mechanisms, and that the central nervous system is a system of conductors which seem to differ from metallic conductors of the type found in an electric wire net-work only in the property that the resistance of the synapses or neurons changes in proportion to the amount of neural flux that passes over them, so that the distribution of the flux is constantly changing. The nature of the changes will depend primarily upon such factors as training, inheritance, and the immediate environment. Of course, a certain normality of brain structure must be present, but even this is inferred from the behavior or the contractile effects rather than the other way around. While I do not wish to underestimate the importance of the cerebral phase of the

sensori-motor arc, yet is not the stress which is being placed upon it due to the assumption that complexity in structure is paralleled by complexity in function? For the behaviorist the central nervous system or the brain is only a net-work of interconnecting neurons. Its anatomical form is a matter of evolution. It does not change its own interconnections.

General

If all of human achievement is to be regarded as the result of sensori-motor processes, and if this achievement is a function of the differences in sensori-motor arcs between the infant and the adult, a list such as the preceding represents the biophysical conditions with which the behaviorist must deal.

Sensori-motor processes are only relatively constant. The actual movements that take place at any given moment depend not only upon the stimulus that is effective at the moment but also on how the neural mechanism has been modified by previous function. Normal activity is rarely the result of a single stimulus. A number of reflexes and habits are always interacting and the behavior of an individual at any given moment is always the resultant of these interactions. In describing a biophysical response the dominant stimulating and contractile effects only can be enumerated. Any reaction once performed changes the resistance net-work of the

nervous system so that even if the stimulating conditions repeat themselves identically the second reaction will not be identical with the first.

For the behaviorist the biophysical responses represent two orders of classification or analysis: (1) An analysis with respect to anatomico-physiological elements; (2) An analysis with respect to their function as stimuli for other individuals. If they are classified according to (1) they represent the terminus of the biological sciences; if they are classified according to (2) they represent the beginning of the social sciences. Much of the confusion between various theories of human behavior and human achievement arise out of a failure to recognize the stimulus character of a response. This biosocial factor will be considered in the chapter which follows.

THE BIOSOCIAL RESPONSES

CHAPTER IX

THE BIOSOCIAL RESPONSES

THE SENSORI-MOTOR COMPONENT IN THE BIOSOCIAL RESPONSES

The Recording Response—The Discriminative Response—The Discrimination—The Test for Discrimination—Elementary Discriminations—The Serial Response—The Relational Response—Generalization and Abstraction—The Self.

By the term biosocial response I have designated those movements or motor effects which establish the individual's co-operative status in the social organization to which he belongs. Speaking simply, the biosocial response is the group of movements or the effects of these movements that other individuals observe and may classify into educational, vocational, administrative, recreational, and personal forms of behavior. The systematic classification of these activities is properly the problem of the social sciences and behavioristic psychology participates in this problem by investigating the ontogenetic and phylogenetic development of the responses as the result of biosocial stimulating conditions acting upon specific types of sensori-motor organization.

The problem of behaviorism is in part that of establishing the fundamental response categories that

are operative in social organization, and concretely this means the classification of the responses in accordance with their resemblances for producing similar behavior in others. The anatomico-physiological elements may be incommensurate.

The Recording Response

This is a sensori-motor system, usually but not necessarily of the speech muscles or writing hand which upon functioning produce stimuli that act upon the receptors of other individuals in such a way that for individuals of the same social status these stimuli are the equivalent of, or a substitute for, the original stimulus which produced the recording response. It is thus essentially a substitute stimulus for objects or events to which an individual whose sense organs were not stimulated by the objects or events might respond as if his sense organs had been so stimulated. Through the recording response, the receptor-effector equipment of one individual, is placed at the disposal of practically every other individual of the same social status. Because of the permanent character in which the response is expressed (writing, printing, etc.) it creates a secondary environment more stable than the primary environment of objects and events which released it. Thus through a recording response such as language an historical

event which has occurred only once can be reproduced (within certain limits) practically at any time.

The Discriminative Response

The sensori-motor antecedents of the discriminative response are: (a) a specific stimulus pattern which acts on (b) a specific sensori-motor pattern, which releases (c) contractions in some conventionalized effector pattern that is specific for the stimulus grouping, and which effector pattern then becomes a stimulus for others. The act of discrimination is thus a *specific* biosocial response to a specific *stimulus.* In this category are included all those responses which are characterized as being qualitative, or quantitative, *e. g.* red, bright, high, low, tones, odors, tastes, weak, strong, etc. The effectiveness of an individual in a social organization depends upon the type of discriminations he has learned to make, and this indirectly determines his social status.

The Discrimination

It will be necessary to make clear just what we are to mean by *a discrimination.* At any given moment there are many more stimuli acting upon the sense organs than can be enumerated by the individual or by an observer of the individual's behavior who has only the immediate biophysical response as a datum. The effector processes according to which discrimina tions are classified may be deictic or pointing move-

ments toward the specific stimulus, localizing or handling movements, movements of the speech mechanism which enumerate or describe the stimulus or its properties.

The Test for Discrimination

The test as to whether a given discrimination is possible, is some conventionalized response. It is clear, however, that there are sensori-motor conditions in which there is a specific reaction to a specific stimulus in which the reactions are not conventionalized. The metabolic and vegetative processes are examples. The question arises, shall the discriminative response be defined in terms of (a) anatomico-physiological elements or (b) in terms of the conventionalized response? For the writer this resolves itself into the problem of, Shall *a discrimination* be defined in biophysical or in biosocial terms? The behaviorist must classify them both ways. It seems to me that Warren's ('10) thermometer fallacy rests upon this biophysical-biosocial alternative. In his own words, "All the data of science are reported in speech or writing. It is a logical error (the thermometer fallacy) to identify the phenomenon observed with some secondary indication of the phenomenon. The observer's report is merely an indication of his *observation*. To assume that my experience of differentiating two colors is nothing but my

verbal or written report of that experience, would establish a dangerous precedent. One might use it to prove that the tropisms of an amoeba which the behaviorist observes with a microscope are nothing but the behaviorist's own verbal responses or writing movements when he reports these observations. In suggesting this *reductio* I am challenging the logic, not the facts. For the locus of the observed 'experience' remains to be settled empirically" (p. 484).

The force of Warren's argument will depend upon how the terms observation and experience are defined. The physicist when he reports *an observation* implies the existence of some entity within him which *observes* and the record which he (the physicist) makes represents a kind of verdict of this observing or discriminating entity. And to have an experience, assumes the existence of an experiencer and an *event* which is experienced. These are accepted scientific fictions recognized as figures of speech and their application in experimental methods has been so standardized and unified that the fact that they may be untenable has been ignored.

The behaviorist, however, cannot accept this fiction without scrutiny and analysis. It is his business to ascertain just what the *experience of differentiating two colors* actually means. Since science itself is a social phenomenon, *differentiating* can only mean that *two* different sets of movements have been

made: (1) a subject has said e. g., "this is red,—this is green," and (2) an observer has recorded the movements of the subject. While the absence of the movements or of their record does not demonstrate the absence of the stimulating conditions, it does remove the phenomenon from scientific consideration. Even the term 'fact,' which is one of the most firmly established fictions in science, is not a simple or clearly understood thing for the behaviorist. While in general I am sympathetic with Professor Warren's '*reductio*' yet I am so only in the sense that if we use such terms as observation and experience we should define them in terms of our own fundamentals.

For me 'I am observing,' only means 'I am responding' and 'I am experiencing,' also means 'I am responding.' When I am asked to define what I mean by a response, I can only refer to a biosocial analysis such as that which is the subject of this book, in which my fundamental assumption of an electron-proton movement continuum, defines the 'response' as a movement in one of the loci in this continuum. This meets Warren's requirement that the locus of *the observed "experience" remains to be settled*, but not his requirement that it be settled empirically. I do not see how this could be done. I have adopted the method of mathematics, namely, that of assuming a locus for the response. This is a biosocial act

or a conventional series of movements. When we establish the test for *a discrimination* we must repeat this arbitrary method. Unless, however, we agree upon whether the test for a discrimination shall be its biophysical or its biosocial properties, all controversy and discussion is futile. The problem of the analysis of human behavior makes it seem to me, at least, inevitable that we shall adopt the biosocial properties of our movements in defining a *discrimination*, but the question of explanation or the antecedents of movements is ultimately a problem in biophysical classification.

Elementary Discriminations

Every stimulating condition must act upon a sense organ before differential effector processes can occur. The type of discrimination that is developed is thus limited by the structure and properties of the sensori-motor system. The degree of complexity of the discriminative responses varies from relative simplicity and uniformity from individual to individual to an unanalyzable complexity. Those discriminations that have a high degree of uniformity between various individuals I have arbitrarily designated as elementary discriminations. Thus a visual stimulus acting upon the normal eye of an English-speaking individual may release the biosocial responses of red, green, blue, yellow, light,

dark, etc., and these responses as they are acquired by different individuals soon become relatively uniform in the sense that the responses for different individuals will be uniform for the same stimulus. Further the more complex visual stimuli may all be analyzed into the seven categories of redness, greenness, blueness, yellowness, brightness, extent, duration. Thus the color purple can be differentiated into redness-blueness (or reddish-blue). The visual stimulus of an orange may be analyzed into the elementary discriminations of *reddish-yellow* of high saturation and medium *brightness*, round in *extent*, and visible for the *duration* of five seconds. At the present time these discriminations are verbal discriminations or specific effector processes in the muscles of the speech mechanism. This, of course, means that the discrimination of redness, is an acquired or learned reaction already very complex from the sensori-motor standpoint. Just what the sensori-motor conditions may be in a child when its eyes are stimulated for the first time by the ether vibrations corresponding to red light, or whether there is a differential effector condition at all, we do not know. The adult discrimination of "redness" is certainly not the original response. The following list contains the important elementary discriminations: size, shape, volume, distance, extent, intensity, direction, red, green, blue, yellow, vocality, tonality, loud,

warm, cold, pressure, pain, sweet, salt, sour, bitter, fragrant, foul, resinous, burnt, fruity, spicy, movement of the body or parts of the body, up, down, right, left, posture, hunger, thirst, fatigue, duration. This list is not complete. It represents merely the type of responses that are relatively uniform from individual to individual. In combination these discriminative responses make up the objects and events of the individual's environment.

The Serial Response

This sensori-motor type of organization is at the basis of the verbal more-less, greater-smaller, weaker-stronger, etc., forms of responding. It is the beginning of the series of responses (relations) for which there are (apparently) no stimuli. The problem is that of investigating how the individual learns and uses the measurements in his cooperative activities.

The Relational Response

In these responses the stimulus is a *relationship* (qualitative, spatial, temporal, social, etc.) between objects or events. The problem is that of determining how a relation between stimuli can itself become a stimulus and release a specific response that is independent of the nature of the stimuli. In traditional psychology this was regarded as a mental process

and when investigated by the method of introspection yielded auxiliary responses which were classified under various groupings of sensations, images, feelings, etc. The problem of determining how such a verbal response as 'one-half' to two such different stimuli as, e. g. a half orange and a bottle of milk half full can develop, has always presupposed some non-biological factor (mind, meaning, consciousness) which did the relating. The relational response as formulated in its traditional paradoxical form, "If a relation between two objects is not a stimulus, how then can we react without being stimulated?" is answered behavioristically by the fact that our educational system is largely a device for supplying artificial objects (words, symbols, etc.) which become very definite stimuli for these relationships.

Generalization and Abstraction

We have seen how, with the growth of complexity in sensori-motor organization, the language response becomes more and more important as a stimulus. The relationship is reciprocal. The growth of language develops more complex sensori-motor organization; and this in turn reacts upon the language responses until we reach a stage in which the behavior is apparently independent of the nature of the immediate objects and events that act upon the sensory mechanism. Thus a generalizing response such

as the word *food* is released by many forms of stimuli which are biophysically incommensurate, and on the other hand the word *food* (as a stimulus) may release many responses (different ways of handling food). When this type of sensori-motor organization includes *relationships* the responses are called abstractions.[1]

The stimuli are *relations*, and the responses are of the recording type which, for other individuals, serve as substitute stimuli for the whole series of conditions under which the original relational sensori-motor patterns were established. The exact form which these generalizations and abstractions may take, depends not only on the sensori-motor possibilities of the individual but upon the whole linguistic and social history of the race. To quote from Professor Leonard Bloomfield's ('14) work on comparative linguistics, "Chinese may, indeed, serve us as an example of a language with parts of speech entirely different from ours. It has no such parts of speech as noun, verb, adjective, and adverb. 'Good' is a quality, 'man' an object, 'speaks' an action in China as everywhere else, but the fact that these experiences belong to these different spheres is not expressed in the Chinese sentence" (p. 126). Facts such as these

[1] We are not concerned at this time, how these reactions are established, except that they are language responses. A detailed behavioristic account of the development of language and those categories that have been characterized as "generalization and abstraction" can be found in Max. F. Meyer's books.

show just what traditional psychology has been designating as the *mental* factor. From the behavioristic standpoint the difference is only one of language habits and the *oriental mind* is largely a linguistic difference as expressed in those responses which record the generalizations and abstractions of the social organization.

For the behaviorist all this must be explained on the basis of what I have designated as the biosocial response. When the fiction of a *mind* or *psychic factor* is recognized as of the same sort as the *hypothetical observer* in physics or the conception of *special creation* in biology, the *mental factor* will also vanish from the study of human behavior.

The Self

The sensori-motor pattern which may be regarded as specific for this form of response is also a relation between stimuli. Mechanically we have two types of sensori-motor organization which may function with any form of stimulation: One type (a) made up mainly of sensory patterns which are only stimulated by conditions arising in what we designate as our own body and for which the conventionalized response is *I*, *me*, *myself*, etc.; another type (b) of those sensory patterns which are stimulated (relatively) independently of the body, and for which the conventionalized response is *you*, *it*, *they*,

etc. How this type of sensori-motor organization is established is unknown, but it should be clear that when we say a child has developed a consciousness of self or is self-conscious, this is no explanation but merely an ambiguous and unclear restatement of the fact that the child (or the reactor himself) has now developed a sensori-motor type of organization that gives the *I, you,* type of response in the conventionalized manner. The essential fact is that a sensori-motor organization has been established which may function in such a way that only two specific types of responses are released, no matter what sensory patterns are stimulated.

For the behaviorist the concept of the *self* is a specific response. It is not a non-biological entity which responds to the social and physical environment by having experiences, perceiving, feeling, thinking, etc., in the sense of the self-psychology developed by Professor Calkins, which is dualistic, with the attributes or properties of the self (malice and envy, for example) being of essentially the same character as those usually described by traditional psychologists as mental. While there is, of course, no desire on my part to restrict or reinterpret self-psychology, I do not see the intimate relationship which Professor Calkins professes to see between self-psychology and at least my own conceptions of behaviorism. For me, the self is one of a class of

verbal responses which I make and which may act as stimuli on the sensory mechanism of others under certain conditions. For the behaviorist who investigates that activity which may be described under the traditional classification of *the self* the study will be of the social or historical conditions which lead to the formulation of this type of sensori-motor pattern. For this a study of comparative linguistics and experimental work in language formations will replace the usual introspective technique of traditional psychology.

I have placed co-operative behavior at the basis of social organization, and some of the co-operative responses may enter into reciprocal relations with other of the individual's own movements. This may be called self-activity, purpose, etc. Just as the individual is a co-operative unit in a social group, so his own action at any given moment may be regarded as a co-operative unit in his own life history.

THE SOCIAL STATUS

CHAPTER X

THE SOCIAL STATUS

THE BEHAVIOR LIFE HISTORY: *Educational, Vocational, Administrative, Recreational, Personal Behavior*—THE INDIVIDUAL'S BEHAVIOR LIFE HISTORY—VARIABILITY OF REPRESENTATIVE LIFE HISTORIES—SIMILARITY IN LIFE HISTORY SEGMENTS—THE CLASSIFICATION OF HUMAN BEHAVIOR: *Specific Behavior, Behavior Rank.*

The human individual is not only a synthetic organization of bodily structures functionally interrelated, but he is also a unit in a larger social organization. As such a unit his behavior may be classified, not only with respect to his own welfare, but also with respect to its relationship to the other members of society. Such a comparison exhibits similarities and dissimilarities which form the basis of a series of behavior categories. These categories may be based on educational status, vocational conditions, political affiliation, etc. Under ideal conditions it would be possible to classify an individual's behavior with reference to some standard or norm. The classification would represent his social status at the moment. The social status of two individuals is defined as similar to the extent that their biosocial responses to equivalent biosocial stimuli are equivalent. Two bank-presidents may be socially equal from the

popular point of view because both have about the same income, belong to the same clubs, and direct banks of about equal financial rating. Yet one banker may be religious, the other indifferent; one generous, the other miserly; one active politically, the other active in civic beautification. From the standpoint of behavior they would be more unlike than alike.

This form of popular social stratification is not restricted to the higher ranks. Two day laborers may exhibit behavior differences more diverse than that of two bank-presidents. One laborer may be thrifty, temperate, send his children to school. Another may roam over the country, neglect his family, beat his wife, go on sprees, have a police record. Yet statistically they would both be regarded as day-laborers. At the present time the social position of an individual furnishes a very inadequate and vague description of his behavior. Such categories as already exist are traditional. Originally they were behavior classifications but with the changing social conditions the original behavior names became attached to the persons and their offspring even though the behavior changed a great deal.

The social status is not to be regarded as a ladder or scale of values. All individuals whose actions are alike are of the same social status with respect to the given activity, although they may differ widely with

respect to other activities. The social status of the individual is merely an enumeration of the various types of behavior and the rank of the individual in these behavior series.

The responses of an individual cannot be regarded as independent units. Just as a single muscle fiber is always a part of a co-ordinated muscle structure, so every response is related to the actions which preceded, those that occur with it, and those which are to follow. Instead of speaking of responses it would be more correct to speak of response series, the most comprehensive of which is the behavior life history of the individual. In this sense we can group together different response categories and develop a complete classification of human behavior.

The Behavior Life History

This includes the totality of the behavior series, from birth to death, which establishes the individual's status in the social organization of which he is a member. Until a scientific biosocial classification of human behavior has been developed, those forms of behavior usually included under (1) educational, (2) vocational, (3) administrative, (4) recreational, (5) personal, seem least ambiguous.

These five classes may be subdivided into classes which are made up of responses having an ontogeny, phylogeny, and a social history of varying degrees of

complexity. Behavior categories are social categories freed as much as possible from individual differences. The classifications at present are irregularly based on tradition, geography, race, religious, economic, and other factors.

Educational Behavior—Under this heading may be classified those responses which are learned and which extend the range of the individual's behavior repertory beyond that which would develop through growth and with a minimum biosocial environment. Most adult reactions are not learned at once, but are serial in character, terminating in some final biosocial condition. The intermediate connecting responses are the so-called *means* toward an end. The various systems of instruction and learning both private and public, as exemplified in the many types of schools and colleges, represent the various forms of educational behavior. Since no single individual is able to acquire all the forms of behavior that are taught, the educational system is also designed to classify the behavior series with respect to their effectiveness in producing particular social results. Thus some educational systems prepare for medicine, others for literature, business, stenography, engineering, automobile repairing, dress-making, etc. This limitation of the individual to acquire only a part of the sensori-motor modifications, restricts him to one of a number of behavior series. The educational

methods expose the individual to a number of life histories, of either actual or hypothetical individuals and the intensity of these histories as stimulating factors for different individuals is supposed to act selectively on the inherited and acquired sensori-motor conditions so that the most effective behavior for co-operation is acquired. Of the educational institutions the most obvious are: Formal elementary, secondary, and higher education, apprenticeships, clubs, etiquette, religion, the press.

Vocational Behavior—This type of activity is made up of the co-operative responses through which society as a whole maintains its stability and essential organization and includes the trades, professions, and all those response or behavior series which the individual exchanges, directly or indirectly, for conditions which extend the range and specific character of his personal behavior. No attempt will here be made to list the various forms of vocational behavior. With respect to specific types there is a great deal of over-lapping.

Administrative Behavior—This class includes those responses through which the social organization is maintained. It includes, besides, such forms of behavior as leadership, executive ability, and rules by which social organization is regulated.

Recreational Behavior—These responses represent the play activities through which the individual develops variety in his behavior. Games, sports, travel, amateur activities of all kinds, hobbies, avocations, theatre, concert, and the many forms of sociability.

Personal Behavior—In this class may be placed those forms of behavior which differentiate one person from another. Personal habits in eating, dress, manner of working, discussion; personal reactions to objects or other persons, as affable, loyal, emotional, optimistic, stolid, stupid, bright, co-operative, neurotic, melancholy, etc. Very little has so far been done in developing the behavior categories into which the responses of the normal individual may fall. The traditional psychological classifications of individuals into visual types, auditory types, kinesthetic types, etc., are a beginning but as yet the biosocial significance of these types has not been established. It is of course recognized that the specific sensori-motor organization of the individual is the most important factor in determining his effectiveness as a co-operative unit in a social organization, and the exact relation between sensori-motor organization and biosocial effectiveness as represented say in vocational guidance, is one of the most important fields for behavioristic investigations.

The Individual's Behavior Life History

Behaviorism is based on the assumption that the individual's activities from birth to death, form a causal series in which all the activities which have preceded a given act are the necessary antecedents of this act. The causal relationship between actions exhibits varying degrees of remoteness but a *complete* explanation of any given form of behavior in a given individual, requires a complete description of not only the behavior ontogeny of the individual but the behavior phylogeny of the race. Under the conditions of practical analysis, such a complete description is not possible or necessary. To say that every action is causally related to all other actions that follow, is true, but in the classification of human responses, some antecedents are more significant than others.

It is assumed that two individuals with identical inheritance and developed under identical environmental conditions would have identical behavior life histories. This degree of identity is of course only a limiting condition, which is never realized, but the more closely the stimulating and the sensori-motor conditions coincide, the closer will the two behavior life histories coincide. The behavior repertory of an individual between two time limits represents his social status for the interval. Since no two individuals have the same inheritance and the same environment, the behavior life histories of any two in-

dividuals will differ. The resemblances, however, are sufficiently close to be classified. Thus the action of signing one's name occurs frequently. Biophysically no two successive signatures even for the same individual are identical and the act varies still more among individuals, but from the biosocial standpoint "attaching one's signature" has become a part of a well established and unified co-operative activity.

Variability of Representative Life Histories

An adequate classification which includes the life histories of all individuals does not exist at present. The actual record of the biosocial responses and their genesis for any given individual from birth to death or even for any given interval have not yet been recorded in such detail or according to such conventions that normal life histories can be compared with each other and formulated into a conventionalized or standardized series. Even the simplest life histories of unskilled laborers have not been classified on any scientific principle. When the social stratification between groups is relatively weak, the life histories of individuals become very complex and intermingled. For this reason human behavior is more satisfactorily classified on the basis of social similarities than by individual similarities. This branch of the behavioristic study of human behavior is now be-

ginning to make contributions under the name and technique of mental and social measurements. But the postulates are still more or less those of traditional psychology, in which the individual's responses, at least implicitly, are regarded as a manifestation of some non-physical or mental entity.

Similarity in Life History Segments

Notwithstanding the dissimilarities between life histories, taken as a whole the behavior segments of an individual's life at any given time belongs to a more or less clearly defined category of activities within the group organization. These organizations vary from one as stable as the family circle, to one as variable as a national or racial group temporarily associated to achieve some specific end. Any individual life history segment extends backward diverging more and more from what might be regarded as the average of the group.

The activities which characterize the group are more uniform and stable than those of its individual members. Thus *teaching* as a group activity is more unified than the behavior of the respective teachers that make up the group. We have thus a group life history and the individual develops his own life history as a composite of the various groups, clubs, societies, organizations, to which he belongs. The actual composition of a group may be based on

tradition, or on the co-operative needs of the community. From these activities the individual establishes the social status to which his own behavior belongs, the social status to which other individuals belong, and to some extent the social status to which his own actions are leading.

The Classification of Human Behavior

This is a difficult problem. The writer has suggested the five general classes: educational, vocational, administrative, recreational, personal. The responses under these classes present a qualitative, a quantitative, and a co-operative aspect. Suppose golf-playing is classified as recreational behavior and that all golf-players are included. However, not all golf players are equal in skill. The mere novice is to be differentiated from the expert, and this introduces the quantitative factor. The type of behavior that constitutes golf-playing irrespective of skill we propose to call *specific behavior,* while the degree of excellence or skill is to be denoted by *behavior rank.* This leaves open the larger question as to the status of golf-playing as a co-operative activity in social organization. Classifications on the basis of specific behavior and behavior rank have been developed with respect to certain abnormal classes, types of insanity for instance, but for literary, artistic, scholarly, mechanical, industrial, financial, legal activities, no

scientific classifications have been established. At the present time we have only a vague conception of what is meant by a *legal mind* although we recognize that the distinction is an important one.

Specific Behavior—Two forms of behavior may be regarded as equivalent from the specific standpoint when they are similar biosocial responses to similar stimulating conditions. As types of specific forms we may include such behavior segments as: arithmetical calculation and under this as subclasses, addition, subtraction, multiplication, division; under each of these as subgroups, adding by two's, three's, nine's, etc. Again a specific behavior category may be that of machinist. Under this we may have the groups, automobile machinist, steam engine machinist, lathe man, planer man, die maker, etc. The automobile machinist class may again be subdivided into such subgroups as carburetor expert, ignition expert, radiator expert, crank-shaft expert, etc. The number of specific categories in the trades alone runs into thousands. The personnel workers are beginning to formulate such categories by the method of job analysis. The investigations are at present restricted mainly to the schools and the industries but the advantages of a careful classification have become so evident that analysis will no doubt extend to all forms of behavior including, for instance, theorizing, thinking, designing, accuracy in making observations,

skill in verifying theories, skill in assembling data, skill in interpreting data, etc. Many high correlations will be found between some specific activities which biosocially are very different: many low correlations will be found between types of specific activities which biosocially are regarded as similar or identical. For instance, when we speak of scientific ability we assume that every scientist is equally able in formulating theories, in preparing the experimental conditions, in making careful observations, in interpreting the results. A little reflection will show that this is not the case. On the other hand, the enormous differentiation in the trades is probably merely an economic differentiation.

By the refinements in individual and group measurements that are being developed the difficulties in bringing the infinitely diverse forms of human behavior into groups and classes of manageable dimensions has been wonderfully simplified. Already a beginning is being made through the use of the method of intercorrelation in order to find those forms of activity which correlate low with each other. This is one method through which *specific* types of behavior will be isolated. This is a difficult problem since the behavior which is now being tested conforms to economic and curricular standards rather than to the sensori-motor structure of the individual. There is some criticism because the mental testers are not

trying to restrict their efforts to testing what are called mental functions or mental processes. Such criticism usually arises from those who have not tried to test mental functions. Mental types or behavior types are analytic derivations from behavior life histories. To devise a test which will test only *attention* and nothing else, assumes to begin with that attention is a faculty of some sort, commensurate between different individuals. If, on the other hand, attention is regarded merely as a form of action which increases the effectiveness of the stimulating conditions to release responses, *a general* test for attention is seen to be impossible. From the behavior point of view the so-called mental tests are actually tests of social behavior and not tests of hypothetical mental functions.

When the conception is accepted that such terms as consciousness, purpose, volition, thinking, attention, emotions, etc., refer to movements (not mental states) experimentation on the more complex forms of behavior will begin. Even introspective technique may contribute to the biosocial analysis of behavior classes. However, to base a social psychology upon such conceptions as the feeling of sympathy, the will to power, satisfaction or dissatisfaction, the desire for fame, etc., as has been done in many psycho-sociological systems, is confusing rather than enlightening.

Behavior Rank—From the biosocial standpoint certain forms of behavior are regarded as similar qualitatively but different quantitatively. Thus certain reactions may all be classified under military behavior and then be further divided into the specific duties of the general, the captain, the private. When the classification has reached the degree of differentiation in which all individuals of the same class perform the same movements, a further classification is possible that is based upon the effectiveness for cooperation between individuals by whom these movements are performed. Thus two privates in the same company may perform the same specific military behavior but one private performs his tasks in less time and with fewer errors than the other. This is to be regarded as a difference in *behavior rank.* In the same way, one general may be regarded as a *better* general than his colleague who performs the same specific activities. Two housewives may perform practically the same specific tasks but one of them does her work far more efficiently than another. These differences represent differences in *behavior rank,* but no differences in *specific behavior.* It may, of course, be urged that a task poorly done is not specifically the same task as that which is well done even though society recognizes only a quantitative difference. However, the distinction exists and forms the basis of what has been called social

values. Behavior rank is expressed in many different ways, from a vague implied standard such as public opinion to the more quantitative designations as, above or below the average, subnormal, supernormal, novice, journeyman, expert, grade, rank, percentile, mental age as opposed to chronological age, intelligence quotient, etc.

The so-called mental tests have made many important contributions as is shown by Professor L. M. Terman ('24) but at the present time a feeling is becoming articulate by many psychologists that the methodology is far from emancipated from the philosophical, psychological, and educational traditions, and that these traditions are leading the mental test program into a *cul de sac* from which escape is only possible through a smoke screen set up by Monroe calculators.

The most comprehensive and original program of behavior analysis which is based upon anatomical, neurological, and biosocial postulates, is one which was initiated and is being conducted at the Bureau of Personnel Research at the University of Missouri, by Professor M. F. Meyer ('24). If the testing pieces listed by Meyer prove to possess the independence (lowest possible correlation with each other) which they promise, the specific behavior classes which are postulated by the present writer may eventually reduce themselves to a dozen variables in

place of the seemingly hopeless tangle of activities that are implied when the popular educational, vocational, recreational, administrative, and personal classifications are used.

CONSCIOUSNESS

CHAPTER XI

CONSCIOUSNESS

The Structure of Consciousness—Introspection—Mind as Function—Mind, Mental Process, Mental Element.

Many of the psychologists who accept a psychical entity and support the existential reality of mental states as distinct from biophysical and biosocial processes, are determinists but nevertheless fail to indicate how mental states are the determiners of human achievements. This situation is due to what I have in an earlier chapter designated as the intimidation of metaphysics. Many psychologists refuse to make a definite statement on the mind-body relation, maintaining that this is the problem of metaphysics with which psychology has no concern. When, however, the writer, the statesman, the educator uses the psychological conceptions that have been taught him, he forgets the limitations which were imposed and uses mental forces not as hypothetical metaphysical limits but as physical forces which are the essential antecedents of the human actions which he wishes to control. For the population at large, and this includes the most highly educated, the mind is something subject to persuasion in the same sense that a gentle pressure on the steering wheel of an automobile will

change the direction in which the car is moving. When the non-scientific person begins to investigate his own behavior, or begins to 'psychologize,' he finds himself able to make a series of discriminations of internal and external conditions which he never *dreamed* existed. This is, of course, to be expected. The average man or woman is not taught to make separate discriminations of his own effector processes. Psychologizing is not a spontaneous activity for most people, and where people are instructed to psychologize there is usually some one present (the psychologist) who helps the novice to classify the new discriminations that he makes. This is remarkable only in psychology. The geologist does the same thing, but he does not call it geologizing, he calls it teaching geology. In psychology, however, it is assumed that the novice requires no preparation. Any one is supposed to be able to psychologize if *he sets his mind to it.*

In traditional psychological classifications two independent categories are first established. One which includes consciousness, awareness, mind, mentality, etc., designated as the *psychic* or mental phase of experience; the other category includes such phenomena as the bodily reactions of running, walking, manipulating objects, and those movements that occur more or less automatically, designated as the *physical* or physiological processes. In this chapter we shall try

to show that the psychic aspect is as superflous in the study of human achievement as it is in geology. It would be an endless task to criticize all the theories of the relation between mind and body and all the psychic categories that have been developed during the three thousand years that this problem has been discussed.

We shall begin with an analysis of a few conceptions of consciousness and try to show that they cannot be incorporated into science without a duplication of principles which obscure or mix the scientific principles that are adequate by themselves.

The Structure of Consciousness

What is loosely known as structural psychology has recognized two sorts of existential phenomena, mind (psyche) and body (matter). Consciousness is psychical. The elements into which consciousness may be analyzed, are three in number: sensations, images, and feelings. All conscious states, no matter how simple or complex they may be, are said to be compounds of these three elements. The elements have no physical properties, and their psychical properties usually termed attributes, are quality, intensity, extent, and duration. Not all the psychologists who agree up to this point will accept these four attributes as describing consciousness. Stout ('19) for instance, maintains that "consciousness itself is not

susceptible of a positive definition" (I p. 1). Other psychologists have made the attempt to define consciousness in terms of experience, but this term is no clearer than the term consciousness, and the result is a definition of the type *consciousness is experience and experience is consciousness.* This is part of the controversy on sense-qualities on which there is practically no agreement. Disregarding this, however, the structural psychologist reduces the manifold of the so-called experiences of the individual either to these three elements or to whatever his own particular elements may be. If one were to start, as the writer has tried to do, to find a list of the attributes of consciousness that are common to any group of psychologists, he finds that the difficulties in interpretation become enormous. One finds much discussion about the difficulty of the subject-matter and the fleeting character of conscious processes. The definitions of the conscious complexes such as perception, emotion, volition, ideation, etc., reveal little if any, uniformity and each psychologist develops independent classifications or merely assumes that the reader knows what is meant.

There is no objection to controversy and lack of agreement as such. This is characteristic of all science. However, in natural science the controversy tends to establish agreement. The facts revealed by experimentation after a certain amount of verifica-

tion are generally accepted. In psychology which is one of the oldest fields of study, the agreement now is less than it has ever been. Not even the validity of its experimental technique (introspection) is agreed upon. Some hold the introspective method as adequate, some question its validity, others maintain that its findings are irrelevant. This sort of thing has been going on for five hundred years. The only psychological proposition that is generally accepted by traditional psychology divides the world into two entities, the *physical* world as it presents itself to us as atoms, molecules, substances, forces, motions, organisms, etc., and a *mental* or conscious world made up of such things as sensations, images, feelings, percepts, concepts, etc. The interrelations of the physical world and the mental world exhibit all the degrees of causal interdependence ranging from the physical world as an epiphenomenal manifestation of the mental world, to the other extreme in which the mental world is regarded as epiphenomenal to the physical world. The popular conception of the relation between consciousness and behavior is best given by Stout ('19) as "Conscious process, besides being conditioned by physical and physiological antecedents, is also itself continually initiating physiological and psychical consequences" (I. p. 28). In spite of many involved[1] discussions on

[1] It should be remembered that Stout maintains that consciousness itself is not susceptible of positive definition.

the nature of consciousness, the result of these discussions has left the educated public with the conception that consciousness is some kind of non-material force or entity, which has no physical properties but which nevertheless acts on the nervous system of man in some unknown way, so as to control his behavior in conformity with some teleological plan, the nature of the teleological plan being determined by "consciousness." Professor Stout does not make this as a direct statement, and should not be held as supporting this point of view, yet is it not just this point of view which his students will carry away with them?

Many writers take it for granted that when they use the term consciousness everyone else uses it in the same sense in which they use it. Thus in an able discussion of the influence of biology on psychology, Professor Davies ('23) states: "I do not see that behaviorism, so long as it remain on scientific grounds, can be criticized for starting with the reality and observability of behavior; but if and when it discusses the mental order, either as something that does or does not exist, it is open to the criticism of raising a question which, because the answer to it must ultimately rest upon an appeal to consciousness, undermines its own position" (p. 175). Of course, this statement is meaningless to those who deny the existence of consciousness in any traditional sense in which the term is used. A general definition of the

type,—consciousness is *that something which* specifically may be characterized as redness, sweetness, affection, awareness, envy, etc.—has proved inadequate, because no agreement could be reached as to just what biophysical or biosocial facts were to be included under the terms, redness, sweetness, etc.

For one who would define human behavior as a form of motion for instance, an appeal to consciousness is merely an expression of futility; one might just as well appeal to intuition. If we pass to the extreme represented by Professor Wheeler ('23) consciousness seems to be regarded as a physico-chemical (or physiological) process. "All we know," he says, "about the problem (consciousness) is the fact that as yet science has not discovered an adequate method of investigation whereby ideas can be studied directly, after the fashion of studying chemical processes in a test-tube. . . . Hence there is no positive evidence that mental processes are 'subjective' as contrasted with 'objective'" (p. 110). Certainly Davies and Wheeler are not referring to the same phenomenon. Suppose, however, that Wheeler is successful in his reduction of what he calls consciousness to an objective condition. What justification is there for calling anything by the name of consciousness which can be completely reduced to physics and physiology? The fact that an analysis is now impossible does not justify Wheeler's subjective ter-

minology. There are many physical problems which elude the physicist's skill but he does not call these *unknowns* anything but unknowns, nor does he regard them as psychological problems. An *idea* that is a physiological process, is not an idea in any historical meaning of the term, even though the precise type of physiological process or relationship is one of the chemical or physiological 'unknowns.' If consciousness is objective, then a physico-chemical or neurological analysis (not introspection) is the most effective analysis.

Professor Fernberger ('22) recognizing the inadequacy of the older dualism tries to achieve clearness by reducing the older psychical or conscious factor to what seems to me a terminological variant of one phase of the physical factor. "The material of this science," which he calls the science of consciousness, "is merely the conscious middle term in the reaction chain and nothing more. In this we would include a study of the conscious elements, of their integration and of conscious meanings. . . . .We advocate, then, the separation of the present psychological discipline into two distinct and independent sciences. Both have their point of view, both have their different interpretative categories, both have their distinct materials for observation, and both have their methods" (p. 411). If there were actually the agreement between psychologists that these statements imply, the

problem would be simple. But first, what is an *interpretative category* and in what way does it differ from an ordinary category? For me the process of *interpretation* is merely the name for the act of classifying, when the things to be classified may be placed in a number of *alternative* categories. I might, for instance, interpret a nervous process in the occipital lobe as: (a) an electrical process, (b) as a physico-chemical process, (c) as some proportion of all the cerebral processes, (d) as a particular part of a given reaction mechanism, etc., but when I am asked to interpret this nervous process as a 'sensation of redness' it ceases to be a matter of interpretation. A new order is introduced. If, however, sensation and nervous process are merely terminological variants of each other, then the two distinct and independent sciences of Fernberger are thus only independent from the linguistic standpoint. One of them studies a part of the reaction chain, and for this part uses a special form of terminology such as calling some phase of a nervous process a sensation rather than a nervous process. Further, it is doubtful whether a behaviorist would accept Fernberger's definition, "The ideal behaviorist wishes to drop the middle term of the intervening mental process entirely and should be interested solely in the two ends —stimulus and reaction" (p. 410).

If I have interpreted Wheeler and Fernberger correctly, they both hold to a monistic system and that a physical one. They recognize, however, that in the analysis of human achievement many factors are unknown, and some of these factors seem to be sufficiently different from the biophysical and bio-social facts that we do know, that the old subjective terminology is justified, but the dualism that originally went with it is not. The behaviorist concludes, that if mental or conscious processes are regarded as particular types of chemical or physical processes of as yet unknown composition then only one entity or one system of events need be assumed and that it would be simpler to admit that consciousness and mind are merely terms that are used as substitutes for any real knowledge of the events to which they refer.

Introspection

Structural psychology implies that the process of introspection yields data which describes some phase of consciousness. If, however, the term consciousness itself is not clearly defined, whatever may be said of introspection will be equally unclear. From the standpoint of the behaviorist introspection is an implicit form of behavior in which the subject responds to his own responses. Implicit reactions are the residual and obscure internal effector processes remaining from the auxiliary processes that accom-

panied the learning of the original overt reaction. Since the effector pattern of the auxiliary reactions is usually not localized, the implicit reaction when described by the individual is usually described in terms of the original *receptor* patterns which were at the time clearly discriminated. When experimental conditions are created by which a response is frequently repeated under controlled stimulating conditions, it is possible through the use of supplementary stimuli such as auditory instructions to *attend* to this or that phase of the reactions, and to learn to localize or enumerate some of the auxiliary effector processes.

While the auxiliary effectors are functioning, they stimulate adjacent receptors, but ordinarily the sensori-motor processes from these adjacent receptors are distributed to other equally obscure effectors. However, in the presence of a relatively strong verbal stimulus of the type *report your imagery* or *report your mental states* some of the subjects's discriminative reactions are shifted from the receptors that are stimulated by the experimental stimulus to the kinesthetic receptors that are stimulated by the effector processes of the subject's own response. The auxiliary stimuli (instructions) and the experimental conditions are so selected that the discrimination of the obscure receptor patterns in the subject's own response to the experimental stimulus, are made as favorable as possible. After sufficient repetition and

fractionation overt descriptive reactions are established. Thus the stimulation of the kinesthetic receptors by the movement of the oculo-motor muscles, which under normal conditions release no verbal responses, may in the trained introspector release verbal responses such as *I am having kinesthetic sensations (or images) of eye movements.* New overt responses may be established as when the kinesthetic receptor processes, instead of or in addition to releasing the localizing responses of, *I am having kinesthetic sensations of eye movements,* pass over sensori-motor mechanisms which have just functioned, and establish the overt response *I have a visual image of the stimulus which just preceded.* This is merely a technical form of the normal response *I saw a light.* There is no need for assuming that the overt verbal response, *I have a kinesthetic sensation,* is anything more than a speech reaction whose receptor pattern is in the kinesthetic receptors of the visual fixating muscles and that the subject has *learned* (very rapidly) because of the experimental technique, to pronounce the words, *I have a kinesthetic sensation,* as a result of this stimulation. There is no justification for supposing that just because the subject has been taught to use the word *sensation* instead of merely saying *my ocular muscles contracted,* that he is describing a non-sensori-motor or mental condition. Of course, if the problem is that of ac-

tually tracing out all the sensori-motor conditions that are operative in a given situation the introspective method will reveal many *neural* conditions which could not have been isolated any other way. Because the kinesthetic and organic receptors are widely distributed throughout the contractile and glandular tissues, and under ordinary conditions are not localized, any technique by which they may be localized or discriminated should prove valuable in neurological investigations. It has been shown that the individual can develop verbal reactions to weak kinesthetic and organic stimulations that are beyond the scope of any precision instruments which we have at present.

The introspective technique from the behaviorist's standpoint is essentially a conventionalized form of stimulation (instructions) which produces favorable conditions for the discrimination of: (a) obscure motor effects, either simultaneous or successive, positive or negative, of the type known as sensations, after-sensations, two-point and difference limens, etc., (b) the residual effects of previous sensori-motor functions. After sufficient repetition and fragmentation uniform biosocial responses to these obscure sensory and motor conditions are established.

The extent to which these auxiliary types of reactions can be developed is well brought out in an article by Professor Wheeler ('22). The problem was

that of analyzing experience under the following conditions. The figures 258 and 135 were arranged one over the other with a line under 135 as in ordinary addition and subtraction. The reagent (Wheeler himself) was instructed to *choose* between the alternatives of addition and subtraction in reacting to these numbers. Wheeler's report of his unanalyzed and analyzed experience covers over a thousand words. Without the introspective technique and for the average individual the instructions to 'analyze your experience' would probably have released only the response 'I do not know what you mean.' For the behaviorist, Wheeler's analysis is a specially learned form of behavior for which the stimuli are the obscure movements that act on the kinesthetic and other receptors adjacent to the muscle-twitches and other biophysical processes that occurred during the experimental interval. It represents a delayed response, since the thousand words could not have been written or dictated while the so-called 'choosing' activity was in progress. As a problem in human behavior the experiment reduces itself to that of finding out what kind of an environment, training, and inheritance it is necessary for an individual to have to enable him to accomplish what Wheeler has accomplished. That the introspection throws any light on the processes of *choosing* is not clear to me at all, if the final sentence, "In none of

these interpretations did the meanings mature until there developed strong motor tendencies to label them" (p. 434), is to be regarded as explaining the process of choosing. In any scientific sense the problem of 'choosing' can only be answered statistically —how many individuals will subtract, how many will add, under given conditions. An *explanation* of the proportions can only be made on the basis of sensori-motor or biosocial conditions that are different for those who *add* than for those who *subtract.*

If Wheeler's problem had been that of actually tracing out all the sensori-motor conditions that are operative and that can be established under the given stimulus situation, the introspective method revealed the existence of many neuro-muscular conditions which could not have been isolated in any other way. But this makes the experiment one in the discrimination of obscure or residual motor effects, not one in analyzing the experience of 'choosing.' In ordinary scientific observation the responses of the individual to a given stimulus are classified with respect to the established *uniformities* (physical and chemical properties) of the various sciences. In self-observation or introspection the responses are analyzed with respect to the *variety* of personal motor patterns that may be released. These are in any case practically countless and only limited by the response repertory of the subject. For the behaviorist the in-

trospective reaction is a new technical overt response that is *added* to what might be regarded as the practical or socialized response to the stimulus and through which relatively obscure sensori-motor functions may be discriminated and localized. Professor Washburn ('22) calls this 'symptomatic language behavior' and to me this seems an excellent characterization, but it eliminates the subject-matter of traditional psychology.

For the purpose of this topic we accept that definition of consciousness which defines it as the totality of the attributes of the sense-qualities of sensations and images, supplemented by the affective qualities known as pleasantness or unpleasantness. Granting this, any relatively short duration of an individual's life may be completely described by him in terms of the so-called mental or conscious attributes, provided he has received sufficient preliminary training in introspection. This type of analysis may be conducted with all the scientific rigor of any other investigation, but it will of course, yield only what any analysis will reveal, namely, a series of discriminations (mainly verbal) which fit or do not fit into classifications which he has learned in the psychological laboratory or lecture room. It is in this sense that the behaviorist grants a status to consciousness as being a series of speech habits that one learns in a psychological laboratory. Whatever may be the verbal or other

method by which the introspection is reported, it must be a sensori-motor process that originated in sense organs and ends in that series of muscle contractions which we give the name of the introspective report. In this sense the introspective report is an indirect function of the unlocalizable stimulation of obscure receptors and not a description of a psychical process. Refinement of technique and the development of skill in introspection, leads to a more accurate localization of a greater number of the receptors and effectors in a given experimental situation but it does not demonstrate the existence of a non-neural or psychical entity. Whether one goes the step further and postulates a causal or non-causal relationship between the psychical and the physical is irrelevant until the scientific status of consciousness or mind has been established. From the standpoint of human behavior the introspective technique is a group of sensori-motor processes as is any other acquired response. Introspection is a form of behavior in which the individual *responds to his own responses.* That the stimuli which release the introspective report are mostly internal and difficult to localize does not imply the existence of a non-physical category.

The preceding conception of *consciousness* has given rise to other forms which have become more popular because they were less further removed from the soul or spirit theory of behavior and because the

structural psychologists insisted on keeping separate the problem of physical and psychical causation.

Mind as Function

The rather hesitant position of the structuralists in assigning causal effectiveness to the group of attributes which describe the structure of mind or consciousness, led to what is called *functional* psychology. In this system consciousness is not to be regarded as a structure but as a function. We have thus not consciousness but conscious process, not sensation but sensory process, not pleasantness or unpleasantness, but affective process. A conscious process is held to be one of the elements in the *control* of complex human behavior. The manner of control is recognized as not clearly understood, but the principle is justified on the assumption that nature would not have introduced consciousness unless it had some use for it. For the behaviorist the difference between structure and function is merely one of time relations. Digestion is regarded as a function because we are considering a given series of structural changes in the series of anatomical units that make up the alimentary canal or the digestive apparatus, with respect to a given interval of time and in a serial order. Ordinarily when the biologist speaks of the anatomy or structure of an organ he refers to its composition at a given time, usually that immedi-

ately following death and before any changes due to death have started. The function of an organ is merely the series of changes that take place in it, and the relation of these changes to the changes in other organs, during some given temporal cycle. From this standpoint, consciousness as a process or function would be merely the structure of consciousness as it changes from one form to another within certain time limits. In the form of psychology known as *functional psychology*, the term function is not used in the above sense. In so far as functional psychology is distinct from structural psychology it is merely popular psychology in which such popular terms as soul, spirit, ego, are replaced by such terms as conscious process, mental process, imaginal process, etc.

Mind, Mental Process, Mental Element

These terms belong to the same category as the term consciousness. For some writers they refer to the temporal aspect, for some to the dynamic, and for others to the so-called synthetic phases of consciousness.

The term mind, where an attempt has been made to give it a definite meaning, is regarded as the totality of conscious states. Some writers use the term as practically the equivalent of consciousness, as some non-material force controlling our behavior.

Stout ('09) defines mind as follows: "A mind is the unity of manifold successive and simultaneous modes of consciousness in an individual whole" (I p. 1). This conception of mind transfers the real problem to the analysis of consciousness as treated in the preceding sections of this chapter. Neither the term mind nor the term consciousness are used as freely by modern psychologists as they were twenty-five years ago. Instead, the term mental or mental process, mental activity, occur more frequently.

Professor Titchener ('17) more than any other investigator has proposed rigorous definitions for such terms as mind, consciousness, mental element, but inevitably some inner aspect, 'an experiencing self,' proves a stumbling block against uniformity in accepting or understanding the definitions that are proposed. As an example of the difficulties that confront the dualistic point of view we quote from Titchener, "Men of science have set out, on the one hand, to describe the world as it would be with man left out. The result is what we call physical science" (p. 8). After a few sentences in which this is elaborated we read, "But men of science have tried, on the other hand, to describe the world as it is in man's experience, as it appears with man left in; and the result of this endeavor is psychology" (p. 9). After an elaboration of this quotation we find the conclusion; "The *man left in* thus reduces to a nervous

system; and that is the truth of the statement, often met with in popular writing, that the brain is the organ of mind. There is no organ of mind," etc. (p. 11).

If the world with *man left out* is the physical world, and the world with *man left in* "reduces to a nervous system" why again raise the psychical ghost by "The scientific fact is that whenever we come upon mental phenomena, then we also find a functional nervous system; we know nothing of the former apart from the latter; the two orders are thus correlated" (p. 11). If there are only two aspects of the universe, one "with man left out" and the other "with man left in" and if the universe with man left in reduces to a nervous system then the only correlation that can exist is a correlation between the external physical world and the (internal physical) nervous system. This is not correlation, but *causal* relation. There is neither need nor provision for "mental phenomena."

At the present time the type of terminology and the technique of the introspective method may help to localize and describe obscure stimuli and sensorimotor conditions more effectively than through the use of the precision instruments of the physicists. Certainly at present most of the contractile and secretory changes within the reactor that are important for behavior are more readily discriminated by the experi-

menter from the *verbal report* of the reactor than they are by precision instruments that are now available. Thus slight anger may be reported in greater detail and long before the body changes (glycosurea for instance) can be demonstrated physiologically.

Warren ('22) approaches a behavioristic and monistic point of view in his statement, "Our mind, or mental organization, is the joint product of two distinct sets of factors: (1) An inherited physical structure consisting of the nervous system with its receptors and effectors. (2) Acquired experience and modifications of this structure due to stimuli and other forces which act upon it. Examining more closely, we can break these up into six separate factors:

Inherited Structure

Terminal organs and conducting nerves
Central nervous system

Effects of External and Internal Forces

Disorganizing influences
Stimuli and general surrounding conditions
Social influences
Educational influences" (p. 366).

It seems to me that of the six separate factors which Warren lists as making up "our mind or mental organization," the last four are the equivalent of what I have characterized as the biosocial responses.

Warren does not at any rate indicate any specific non-physical or mental factor.

The quotations just cited indicate the range of conceptions which are included under such terms as mind or mental or consciousness. A more extensive analysis would reveal a greater number of intermediate steps and more uniformity than appears from the bare quotations, but when the behaviorist actually tries to determine which of these conceptions has been most effective in impressing itself as a pedagogical principle in our educational practice, Stout's conception, that mind is to be regarded as a non-material causal agent (the functional point of view) approaches nearest to the one which prevails in actual class-room and every-day practice no matter how much it may be repudiated in the preface of the text-books or in the theoretical discussions. After students have been carefully trained to observe the fine distinctions involved in the mind-body relation they forget them as soon as they leave the university. When they get into the business or professional world, they adopt the popular conception of an intelligent mind or consciousness residing somewhere in the brain. The teacher who has had the full quota of psychological courses, talks as glibly of "training the mind" and in the same sense, as one who has never heard of psychology. Whatever may be the systematic value of training students in tra-

ditional psychological distinctions, these distinctions do not seem to meet the requirement of giving a better insight into the problems of human behavior. Such terms as consciousness, mind, mentality, etc., are used with great liberality by everyone except those who have tried to understand what they mean. Popularly they are used so loosely that they have no value except as sonorous and impressive sounding phrases.

MIND FOR THE BEHAVIORIST

CHAPTER XII

MIND FOR THE BEHAVIORIST

Implicit Causation—The Implicit Responses—The Genesis of Implicit Responses—The Sensation—Original Biophysical Conditions—Sense Qualities—The Image—Behavior and Science.

Aside from a few psychologists who define clearly what they mean by the term mind or such terms as consciousness, mentality, mental state, psychical process, these terms are so loosely used that an attempt to develop behavioristic equivalents is useless. During the learning of a new response there are many implicit and supplementary effector processes which can be discriminated by the subject, which cannot be discriminated by an observer, and which can be grouped under a so-called *subjective* category. There may even be some scientific advantage in this, but this is not clear to the behaviorist. Of the two statements 'I am conscious of redness' or 'I am responding to a red stimulus,' the latter seems to offer better prospects for future analysis. The terms mental, conscious, sensation, mind, volition, intelligence, etc., are substitutes for relatively obscure biophysical or biosocial conditions.

Just as soon as these conditions cease to be obscure, they are described in the regular terminology

of biology, or the psychological term changes its meaning and becomes a physical or a social term. For instance many physiologists speak of sensations passing over neurons in a way to practically make the term sensation synonymous with nervous process. And again, the term intelligence, at one time a purely psychological term has now practically become a term that refers to a qantitative aspect of a particular type of socialized behavior or performance.

The term consciousness has played such an important part in psychology and philosophy, precisely because it was *not* recognized as behavior. Traditional and popular psychology regard consciousness as a psychical entity which spontaneously *controls* the activities of individuals. The widespread interest in consciousness or mental states is based upon the practical consideration that an analysis of consciousness will help the individual to control his own or others' behavior. If it can be demonstrated that so-called consciousness does not do this, that no psychical entity has even been isolated, and that what we have been regarding as conscious effort is only the functioning of obscure contractile elements, which in turn stimulate adjacent receptors that release the verbal overt response, "I have such and such sensations, images, and feelings," the whole significance of the term consciousness falls to the ground. It no longer controls behavior, it is only one of the many by-products of

the socially important responses. The behaviorists maintain that the only way to control behavior is through the biosocial stimulating conditions which precede the formation of given groups of activities. The big problem at present is to find out what these biosocial conditions are; preceding even this is the problem of actually defining and classifying the behavior categories. Consciousness as a non-physical, spontaneous, self-initiating form of energy does not exist. Consciousness as an implicit form of behavior or as an obscure physico-chemical process is best described as behavior. Such other subjective terms as volition, perception, reasoning, emotion, conception, ideation, etc., regarded as various conscious complexes, are of course, no more descriptive of biosocial and sensori-motor conditions than the term consciousness itself. The writer has made several attempts to carefully work out the behavior equivalents of the more important traditional psychological terms, but implicit reactions and subvocal speech seem to explain everything. Any attempt to be more specific immediately raises the question, what is the meaning of the psychological term? and here the analysis or synthesis stops in a tautology. For instance, it is said, that the minds of the laborers are inferior to those of the bankers of the community. In terms of behavior this means that if the bankers of the community were assigned the tasks of the laborers (as-

suming equal physical strength) the bankers would do the work better than the laborers. On the other hand, if the laborers were assigned the bankers' tasks, (assuming equal training) the laborers would *not* do the banking as well as the bankers. The differences in ability are said to be due to mental differences, but this is merely a reiteration of the fact that there is a difference. Of the biophysical and biosocial antecedents that are the actual causes of the differences we know next to nothing, and the pseudo-explanatory character of the phrase 'differences in mentality' actually obscures the fact that we have only stated a problem, not explained one. In general, the individuals that excel in the community are said to have the best minds, but of course, this is merely a reciprocal statement for the fact that they excel.

Frequently the term mind is used as a subterfuge to cover up the very important fact that for almost any form of behavior that may be mentioned, no one is able to indicate or describe the *essential* biosocial antecedents through which this particular form of behavior may be established in a normal individual. We have text-books, school projects, course sequences, the elective and prescribed course system; we have large classes or small classes, supervised study, and none at all. All of these in some obscure manner are supposed to act on a still more obscure mind.

The historical question as to how the conceptions of consciousness, awareness, mind, etc., arose is quite aside from the problem of psychical causation. As soon as social organization and social achievement had reached a certain stage the difference between man and the animals seemed to be more than a difference of anatomy and physiology. Man was said to know, feel, perceive, judge, and even create his universe. *Cogito ergo sum*, does not seem to be an animal reaction or the product of an automaton. It is this gap between animal and man which behaviorism is trying to reduce to purely mechanical components, and against which traditional and popular psychology are most active.

In a cosmical sense human behavior is an effector correlate or function of stimulating conditions. The stimulating condition and its sensori-motor effects are always more complex than only the motor results themselves. In man we have a condition in which an organism *responds to its own responses.* In other words, man may analyze a stimulus by the development of differential reactions to its various parts, even down to its ultimate elements,—the electron-proton systems. Animals do not do this in the sense that they participate with man in this type of behavior. The so-called psychical processes are merely some of these analytic responses. Speaking more specifically, consciousness or awareness is merely the name we

have given to the fact that our responses tend to become as numerous as the electron-proton symmetries and systems which we have postulated as making up the environmental complex. Of course, this limit is never reached but man seems to approach it more closely than does any other animal.

Implicit Causation

The implicit response *seems* often to be the essential antecedent of the overt response that follows. I may, for instance, in the act of mailing a letter, have a so-called image of a postage stamp. Shortly afterwards I actually affix a stamp to a letter. It *seems* as if the 'image' were the cause of the affixing act. But stamps are affixed so frequently without preceding images, that their causal character is disproved. The image is rather the functioning of internal and rather obscure motor patterns which at one time were released by a visual postage stamp stimulus but which now are no longer, in any sense, antecedents of the stamp-affixing action.

I may describe my 'image' of the stamp as a 'red two-cent stamp' but this is actually a description of an earlier *stimulating* condition which released some overt response such as handling or inspecting a stamp. The actual neuromuscular conditions of the original response could probably not have been described even at the time it occurred. Whatever residual motor ef-

fects remain at this time are so obscure and weak that they do not even stimulate adjacent receptors and hence cannot be localized or described. The combined effect of the present stimulus and the residual effects remaining in the sensori-motor system may, however, release a verbal reaction such as 'I have an image of a stamp.' Even this response does not occur spontaneously for the average individual. The residual conditions must be reinforced by some such conventionalized auditory form of stimulation as: 'Attend to your image,' 'report your mental states,' etc. The analysis of implicit reactions from the neurological standpoint would require a description of the exact sensori-motor conditions, but there are no precision instruments which measure the intensities of the neural processes in a neural net-work, or the weak contractile processes in the effectors, during the time the implicit response is actually occurring. The auxiliary motor processes or the receptors through which they were released cannot even be localized or designated at any time. As the interval between the original overt response and such residual effects as persist grows longer, the new environmental conditions which are gradually built up around the individual, gradually obscure the implicit components so that they grow weaker, less detailed, and more irrelevant. Generally as the individual grows older his implicit responses become less detailed and in

some cases have been reported as practically vanished.

For the behaviorist the genesis of the implicit response lies in the auxiliary responses which occur during the learning of the new overt responses, particularly those of the social or co-operative type. They represent residual effects, not causal elements in the formation of new responses.

In the transition from the animistic to the mechanistic conception of human behavior the behaviorist is confronted with the problem of explaining certain conceptions and classifications which have been established very firmly and which even though ambiguous seem to refer to real existences. Thus when the behaviorist is accused of eliminating the mind, this seems to imply that he is disregarding something, which no matter how intangible it may be or how little agreement may exist as to its properties, is nevertheless an integral factor in human achievement. To ignore mind or consciousness, say these critics, is merely to restrict the problem. Some one will need to investigate or analyze that phase which the behaviorist disregards. Difficult problems are not solved by ignoring them. This form of criticism has led to clever phrases as, behaviorism is psychology without a mind, psychology is losing its mind, etc. Further, the accusations implied in the terms materialistic, mechanistic, deterministic, irresponsible,

ılso abundant in criticism of behavioristic principles, carries a sentimental appeal that is quite independent of any factual basis. Traditional psychology either implicitly or explicitly affirms that human achievement is the product of forces and conditions which are non-material, non-biological, non-mechanical. To these non-material conditions it has given the names of mind, consciousness, volition, sensation, etc. Suppose for the sake of argument at least that the behaviorist is able to explain human achievement *without* non-material, non-biological, non-mechanical entities. Is he restricting his problem or the original problem of the conventional psychologist? If we take the conventional formulation of the psychological problem, *viz.*, "The study of Mind," and reformulate this in terms of some of the modern conceptions of mind, it becomes "the study of the properties of a non-material, non-biological, non-mechanical, non-causal entity." The behaviorist affirms that his science is a study of the material, biological, mechanical, and social antecedents that are at the basis of human achievement, and he wonders whether this does not represent the expectation of even those who have given us the traditional formulation of psychology better than does the traditional definition. To speak of investigating a non-material, non-biological, non-mechanical, non-causal entity has simply no scientific meaning. It is in this sense that the behaviorist ig-

nores mind or consciousness; he certainly does not ignore or repudiate any of the causal factors in human achievement. He would affirm further that to the extent that modern psychology is itself repudiating the non-causal, non-material entity conception it is becoming behavioristic, even though it is obscuring this by retaining the old subjective or non-causal terminology and re-defining it on the basis of physical and causal conceptions. The implicit responses for the behaviorist are merely those responses that can not now be classified as specifically biophysical or biosocial. They are one group of 'unknowns' in the study of human conduct. Is it not better to recognize them as unknowns than to call them consciousness, subconscious, mental, psychical, etc.?

The Implicit Responses

Stimuli acting on sense organs initiate sensorimotor processes which not only terminate in the effectors of observable biophysical or biosocial responses but also in many other internal effector systems which are obscure in the sense that they cannot be localized by the self-observer nor recorded by an observer. For some of these obscure motor effects the self-observer has developed differential biophysical and biosocial responses which occur only under those stimulating conditions which have been described under the heading of introspection. The implicit re-

sponse is primarily a residual effect of sensori-motor variations that have occurred at some earlier time as biosocial responses. When I have a so-called image of an orange that I have eaten for breakfast, some of the obscure internal effector processes that are now occurring are similar to some that occurred during breakfast, and these motor processes belong to that type of phenomena which the psychologist designates as subjective.

The Genesis of the Implicit Response

To take a concrete case, let us consider the development of an implicit response while acquiring a new overt response, e. g. that of learning to write one's name in a new code form. At the first trial many more movements, internal as well as external occur than after the hundredth trial or after the action has been learned. If we enumerate the conditions that are operative at the first learning trial a list such as the following will result:

1. Some stimulus of the form to be copied, say a visual stimulus of the code form written on a piece of paper.

2. Accommodatory eye movements of fixating, which alternate between the copy, the writing movements of the hand, and with what has been written.

3. Organic conditions of perhaps strain and characteristic respiratory and vaso-motor effects.

4. Tonicity variations in many of the postural muscle patterns besides those that occur in the muscles of the writing hand.

5. Very complicated and relatively slow and unskilled movements in the muscles that move the pencil in copying.

During the learning period these conditions are constantly changing. After practice is complete and further writing shows no increase in speed or accuracy, all unnecessary movements have dropped out and those sensori-motor conditions that remain are the essential antecedents for the biosocial act of writing the code name. What are these essential antecedents?

(1) The original visual stimulus from which the name was copied is no longer necessary, since the code writing may now follow upon an auditory and many other forms of stimulation.

(2) The accommodatory reactions of fixating the stimulus and even those of fixating the actual writing have become superflous and the code name may be written with the eyes closed.

(3) The organic conditions are not the same. Just in what way they have changed cannot at present be determined.

(4) The tonicity of the muscles is differently distributed, but again a specific description of the changes is impossible.

(5) The actual writing movements are fewer in number, and better or at least differently co-ordinated.

We see that after the code-writing activity has been established the actual writing movements are the only ones that remain at all similar to the original learning movements and even here the similarity is not great.

Can the code-writing response be still further simplified? Would it be possible for instance, to leave off even the writing movements? This will depend upon the co-operative situation of which the code writing act has now become a part. If the situation actually requires the writing movements, no further reduction is possible and the code name is written whenever the *new* situation (not the original learning situation) occurs. However, the stimulating conditions may have so changed that even the writing movements are no longer necessary; as, for instance, when a rubber-stamp is substituted for the writing. The dropping off of the now auxiliary movements is not uniform and complete. The intensity of the various motor components gradually becomes less and any variations in the stimulating conditions may release now one, now another in the sporadic fashion in which our so-called imagery occurs. These residual auxiliary motor conditions are the components of implicit responses which, of course, will be ex-

tremely variable on account of the many individual differences and combinations that are characteristic of the environmental and hereditary conditions under which the individual has developed. An implicit response which may accompany any of the final code-writing actions, say a so-called visual image of the teacher who taught the code writing, merely represents a sensori-motor effect that has persisted long after most of the other secondary responses have disappeared. The conditions under which implicit factors may appear cannot be anticipated. They may occur at any time, even under conditions (dreams, illusions, etc.) that are entirely dissimilar from the original learning. The neuromuscular phase of the rubber-stamp act has become a very significant co-operative response, that has no biophysical or neuromuscular relationship to the original code *learning*. No amount of the *reproduction* of any of the original neuromuscular conditions will reveal this biosocial character of the signaling or writing. Throughout life the individual is constantly acquiring new responses and old ones are disappearing, being modified, or being replaced. The residual effects do not disappear as rapidly as new responses are acquired. Our social responses change more rapidly than any others and during their formative period which represents the period of youth in the

individual, their implicit components are very numerous.

From the standpoint of the behaviorist these implicit components refer to phenomena which under such names as imagery have been regarded as the fundamental elements of traditional psychology. Sensations are the antecedents of images and with feeling as a third element, the various combinations of sensations, images, and feeling form the so-called complex *mental* states known as perception, consciousness, mind, conception, memory, emotion, volition, imagination, ideation, recognition, reasoning, thinking, etc.

For the behaviorist, sensations and images must be *movements* and have specific sensori-motor configurations. In so far, however, as the terms sensations and images are used to cover biophysical or biosocial phenomena, even though they cannot be classified as definitely one or the other, the behaviorist is, of course, bound to investigate them no matter what limitations the traditional psychologists themselves have placed on the terms. But the behaviorist is not obliged to respect or even justify these limitations. He maintains that human achievements are biosocial achievements, and this includes everything from the simplest accommodatory reaction to the writing of a text-book on metaphysics. *I have the sensation of redness, etc.*, is certainly

a verbal reaction that occurs under rather definite stimulating conditions and as such presents sensori-motor conditions which may be investigated quite independently of any mind-body implication. This is the behavioristic method.

The Sensation

Suppose that for the moment we neglect all other bodily processes and consider that condition which is described as *perceiving a square of red paper.* The traditional psychologists would affirm that there is in this so-called experience a quality of *redness* which is not in the stimulus, not in the sensori-motor conditions, not in such reactions as reaching, nor in the verbal naming of the color. Now the fact that there are persons who do respond to a square of red paper by saying, *I am conscious of redness*, is unquestioned, and the behaviorist's problem is that of determining the sensori-motor and social antecedents of this response.

Original Biophysical Conditions

The response, *I am conscious of redness* is a rather late effector acquisition to retinal stimulation. If we ask what happens when red light for the first time stimulates the eyes of an infant, we infer the following conditions: A chemical change in specific retinal receptors; the origination of a nervous process which is transmitted over sensory optic nerve

fibers to connecting or association fibers, and finally through motor neurons into groups of contractile elements.

Suppose the infant's reaction is a momentary fixation of the red light source. Experimentally, it may be determined that part of these contractile elements are in the ciliary muscles, in the oculo-motor muscles, in the muscles that move the eye lids, and perhaps the arms, legs, etc., but there is no justification for supposing that there are any of the specific effector conditions which later become the verbal reaction, *I am conscious of redness.* The experimenter can only report that the infant has made certain movements, and so far as infants have been observed, the verbal reaction has never been recorded. In those (older) individuals where the verbal response does occur the experimenter may also observe other supplementary conditions of the following type.

The response usually is preceded by some equivalent of the verbal stimulus, *What do you see?*

The subject is able to *localize* the receptors (the eyes) that are being stimulated and the source of the light by pointing movements or by speech.

If the subject has been trained in physiology he may *indirectly* localize such effector processes as the pupillary contraction or expansion, the accomodatory and convergence mechanism etc., by the descriptions, diagrams, or neurograms in text-books.

If he is trained in introspection, other responses may occur such as verbal, *I have kinesthetic sensations in the oculo-motor muscles, pressure sensations in the eye socket, a visual image of a book with the word socialism printed on it, an unpleasant affective tone,* etc. The introspective technique perfects the subject in responding *separately* to the stimuli that are produced *by his own responses* to the experimental stimulus (the red light in this particular case).

From the behaviorist point of view the technically correct use of the phrase, *I am conscious of redness* means that the subject belongs to a particular social status. He has received training of a particular type, is able to make discriminative reactions of a particular kind, and in general his verbal reactions to particular types of questions will fall within certain limits. For the individual himself the verbal response, *I am conscious of redness* is only one of many responses that he is constantly making. For others the response is a stimulus which indicates that the subject has probably taken a course in psychology, and that at this moment or at some time in the past his eyes were acted upon by red light. This again only means that an individual who uses the words, *I am conscious, etc.* belongs to a different social status than an individual who under the same conditions uses the words, "*Ah done see red.*"

The production of the sounds *I am conscious of redness* is no more symptomatic of the existence of a non-physical or psychical entity than the production of the sound, *I have a dollar.* Both are stimuli which to others reveal certain individual social antecedents, which include the following:

1. Light stimulus in the region of Frauenhofer line A in the normal sun spectrum, acting or having acted on specific retinal sensory elements.

2. Acquired reactions of localizing the object, the sense organ, and some of the effectors which function in the response to the stimulus. This localization may be direct as by touching or pointing, or indirect through speech by the use of such terms as visual, seeing, color, brightness, etc.

There is no necessity to assume that there is another entity such as is implied by the traditional definitions of the terms consciousness or awareness. Such phrases as *I am aware of red* for the behaviorist mean the same thing as, *I am reacting to red.* Speaking more generally, *I am conscious of*, only means *I am reacting to; I was conscious of* means *I reacted to; I shall attend to* means *I shall react to.* A statement such as the following, *I reacted to red because I attended to red*, is not explanatory but tautological. It reduces to *I reacted to red because I reacted to red.* The explanation of how the act was acquired remains unsolved.

Sense Qualities

It is frequently urged that such differences as those between the consciousness of redness and the consciousness of blueness cannot be explained on any behaviorist basis, and that this difference is independent of whatever reactions may be acquired. This introduces the problem of sense qualities, and such questions as, Why is seeing so different from hearing, or tasting? In the first place, the only justification for the statement that there is a difference between redness and blueness must be based on behavior. The individual simply *reacts differently* to a red stimulus than he does to a blue one. If he did not, on what basis could a difference be postulated even granting that there were independent mental states? If it is maintained that the difference between redness and blueness is of a different *order* than between red and orange, just what does the term *order* mean? If it means, how does it happen that the spectral visual series of color responses is relatively *discontinuous* at certain points while the vibration frequencies of the light waves form a *continuous* series, then a difference in the spectral order can only mean that the *effector* processes that are released in passing from red to violet stimulation show greater differences at red, yellow, green, blue, than between these points, and that this discontinuity is not correlated with equal differences when we respond to a precision instrument

which records only the *vibration* rates of the light waves in the spectrum. This means that the retinal sensory process when blue light is the stimulus is not merely an augmented or diminished form of the sensory process released by red light. It is chemically different and the nervous processes reach *different* effectors, not the same effectors in merely augmented or diminished intensity. It is an instance of one continuous process (vibration rate) producing discontinuous effector changes as when a continuous temperature change from zero to 100° C. may produce in water the discontinuous changes, solid, liquid, vapor; all three changes occurring at specific temperatures, all at once and not gradually. Why the sensori-motor conditions when red light is the stimulus, involve different effectors than when blue light is the stimulus can only be explained by the chemical properties of the tissues involved. We know no more about this than why water is solid at —1° and a liquid at +1° and remains a liquid until 100° and then suddenly becomes a vapor at 101°. The same thing is true of the other sense fields. Why a sound stimulus does not release a visual reaction, or a taste reaction, but results in an auditory reaction, is a matter of morphology and bio-chemistry.

In her presidential address Professor Washburn ('22) maintains that the behaviorists have neglected the explanation of the sensation qualities by attribut-

ing them sometimes to the stimulus, sometimes to the response. Referring specifically to the sensation quality of blueness she states: "Obviously, however, the blueness is neither in the stimulus nor in the response, for these are movements and blueness is not a movement" (p. 92). While I would not undertake to prove that blueness is a movement until we have very carefully agreed upon what we are to include under the term movement, I believe that Dr. Washburn will grant the existence of a sensori-motor *correlate* of what she calls blueness. If it can be shown that this sensori-motor correlate is all that exists, then blueness is at least a biological occurrence, and whether this is a movement or not becomes of secondary importance. As a behaviorist I would maintain that the correlate does not exist until the individual has learned to react discriminatively toward those spectral stimulating conditions which are verbally characterized as blue light by the physicist. To have the *sensation of blueness* requires at least: (a) the spectral blue stimulus, (b) the specific retinal elements, (c) a specific sensori-motor organization which is the equivalent of the verbal sound-producing mechanism, *it is blue.* Now, is not the *having the sensation of blueness* merely the actual occurrence of these three conditions? Blueness is not something in *addition* to these conditions. If the self-observer could designate all the anatomical and physiological

factors that are involved, he would find merely a specific sensori-motor condition that is rather complex but always functions when acted upon by light of the specified frequency. Just what this response is, depends upon the biosocial conditions under which the individual has developed, but once established it is constant and this is all that is necessary. For the behaviorist the quality of blueness indicates the fact that the individual has developed a response that is specific for a spectral blue stimulus and that this response is implicit. The question, *Is my blueness like your blueness?* is the same sort of a question as, *Is my tallness like your tallness*, except in the latter case we can describe (measure and compare) the anatomical factors that are involved. In time we shall be able to measure and compare the biophysical and biosocial conditions that underlie the so-called sensory-qualities, but the fact that we cannot do so now is no justification for placing them in a non-physical (mental) category and thus practically removing them from investigation by the methods of modern science.

The Image

The traditional difference between a sensation and an image is usually designated as a difference in vividness, number of details and stability, of the so-called conscious attributes. From the standpoint of the behaviorist the difference can only be one of

sensori-motor conditions. While discussing the so-called sensation of redness, we isolated three steps: (1) a light stimulus, (2) an inherited or acquired reaction of localizing the object or the sense organ, (3) a specific conventionalized reaction to the stimulus. The image of redness is the occurrence of (3) without (1) and (2) in such an incipient manner that an outside observer cannot detect it, but that the self-observer *may* report it.

In the discussion of the architecture of the sensori-motor system, we found that the functioning of the contractile elements was not dependent on the stimulation of the original sense organs under which the reaction was acquired. We should expect then that the conventionalized reaction (the word redness) might occur even though the eye is not stimulated by red light. This form of response we may designate as an image, when the functioning of the contractile elements is not strong enough to act as a stimulus for another individual. The image *redness* from the neurological standpoint is the functioning of contractile elements by a nervous process originating in receptors other than those that functioned when the original reaction was acquired. The implicit reaction which corresponds to the so-called *image of redness* may occur under the most varied conditions: as a reaction to the auditory stimulus, *Think of something red;* an odor may, as we say, suggest it; while

reading a book on socialism, or a description of cardiac activity, etc. If we define a sensation as a response in which it is possible to localize the stimulus and the receptors that release a conventionalized reaction, an image is an implicit conventionalized reaction released by a non-corresponding stimulus acting on receptors that *cannot* be localized.

The 'problem of the image' with its complications has always been regarded by those opposed to behaviorism as the stumbling block against which any strictly mechanical interpretation of human behavior must shatter. I shall try to show that the mystery of the so-called imaginal processes is largely a language difficulty.

Consider the following concrete illustration: I am relatively inactive, sitting in a chair looking out of the window. One who observes me may not be able to detect in such movements as I make any relation to the surrounding stimulating conditions, nor can he anticipate the kind of response I shall make to such a question as, 'What are you doing?' or more specifically, 'What are you thinking about?' Suppose that I am asked the latter question and I report that I was just day-dreaming about a vacation spent in northern Michigan three years ago. Suppose I am then asked to be specific and describe the conditions. I begin by describing one of my images. 'I had a visual image of a tent located on the shore of Lake Michi-

gan. Its location was given by a break between two trees and an absence of underbrush, with a view of a sheet of water beyond. The image did not include the whole tent. There was a bare outline of the front with a partial view of the inside through the flap.'

A behavioristic description of this 'image' would be as follows: *I* am able even now to describe (verbally) an event (the vacation) that occurred three years ago. The whole set of stimulating conditions at that time was strong. The sunset, dark woods, bright break in the trees, the silence and the contrasting white of the tent against the darker background; all of the stimuli released many sensori-motor, accommodatory, organic and tonicity adjustments, with the external posture reactions which may be designated as 'admiring the scene.' The actual internal motor conditions were not localized at the time, nor can I designate them now with any degree of accuracy. Notwithstanding this fact I am able now to reproduce the implicit responses, 'What a beautiful landscape' which I made at the time. The original situation was such that all the sensori-motor processes that were taking place were modifying the neural interconnections between (a) the receptors that were being stimulated by the landscape and (b) the nonconventionalized motor patterns such as posture, respiration, circulation, tonicity, metabolism, etc. Furth-

ermore, even though these were not localized or described by me at the time, the residual effects are still strong enough under the present 'book writing conditions' to enable me to reproduce verbally some of the features of the landscape. I might even make a rough sketch of the tent that I have described verbally.

To do all this, implies (for the behaviorist) the functioning of implicit motor patterns and it is this obscure functioning which I would designate as 'the having of the image.' There is no *something* psychical or mental attached to or correlated with the motor processes. When I am asked to draw my image of the landscape, I produce such movements (drawing and painting) so that another's eyes are stimulated in roughly the same way that mine were stimulated when viewing the landscape. In this there is the assumption that our sensori-motor systems are sufficiently similar so that his motor response will be about the same as mine although I am unable to describe even my own *effector* pattern. Suppose I actually described or drew the imaginal neuro-muscular conditions, as well as might be, and say to my friend, 'Here is my image of the landscape.' I should not be meeting his implied request. When I am asked to draw my image this phrase biophysically means, produce in me a motor pattern which corresponds to the motor pattern which you had when

your eyes were being stimulated by the landscape. Biosocially it means,—stimulate me in such a way that I will respond as you have responded. Obviously, a drawing of my neuromuscular pattern during the time I was having the image would not meet either one of these conditions. In fact, when I am asked to describe any event, this biosocially means, stimulate me in such a way that I am able (without seeing the event) to respond as you have responded (after seeing the event). This may be done in two ways: (a) by stimulating another person's sense organs as mine were stimulated (by a photograph perhaps) or (b) by stimulating his ears with certain sound sequences (verbal description). My verbal description is only a substitute form of biosocial stimulation which, within certain limits, produces in another the same neuromuscular conditions as the original stimulus produced in me. The fact that neither one of us is actually able to describe our own neuromuscular conditions does not enter in. It is not even probable that they are anatomically similar especially when we consider, for instance, the sensorimotor systems of a young person of one social status and an old person of an entirely different social status. To stress the social or co-operative nature of imagery, we may translate the phrase, 'Describe your image of the landscape' into the biophysical and biosocial responses that are the equivalent of '*Stimulate*

me in such a way that my sensori-motor organization will be so modified, that when I am asked to describe the landscape which you described to me, I shall be able to produce in a third person, a motor-pattern which resembled the one you had when your eyes were stimulated by the landscape.' It is in this sense that the image in spite of its apparent privacy is really a social phenomenon. It is a problem that arises when three or more persons form an interacting sensori-motor unit by interchangeably using each other's receptors and effectors. The so-called privacy of the image (or consciousness) arises out of the fact that the individual is unable to localize the anatomical and physiological structures that are involved. The processes of digestion, respiration, circulation, were just as private when the stomach, lungs, and heart were unknown. For an animal, for instance, all of the metabolic processes must be private occurrences, because it cannot describe them to other animals.

If I am not asked to describe my image, the neuromuscular conditions represent residual sensori-motor effects of earlier responses, that is all. What these neuromuscular conditions actually are has not yet been determined. When we know as much about sensori-motor function as we do about digestion, then digestion and imagination will be functions of the same order. That there seems to be a sense *quale* in

addition to the sensori-motor conditions, is merely the fact that if my neuromuscular processes are actually photographed at the time the landscape at which I am looking is photographed, even though the two photographs are not at all similar, it is still possible to work out a point for point correspondence or correlation between the two photographs and perhaps even classify the types of correlation into categories, the equivalent of what we traditionally call sense qualities.

Behavior and Science

The older psychological investigations of behavior started at the wrong end. They *assumed* a non-material control for human conduct without any attempt at investigating the genetic and phylogenetic development of human behavior itself. Human conduct was regarded as the external manifestation of this psychical or spiritual directing force. The conception that the educational activities of the individual are merely a particular category of movements occurring in certain co-ordinated groups of contractile elements has never been generally accepted and in fact is vigorously denied by philosophers and psychologists even today. This is to be expected. It has only been within the last quarter of a century that the properties of the sensori-motor system have been established with sufficient detailedness to understand some of its functions. From the standpoint of

natural science three things may be studied with reference to the human being: The structure of the parts of the body, the function or inter-relations between the parts, and the movements of the body in relation to its environment. Anatomy and physiology study structure and function, but it is only within relatively recent times that bodily movements and their relations to the environment and especially to the social environment are studied as biological facts. A scientific study of the individual can only be a study of his movements and the effects of these movements on the environment. Even when the individual studies himself, he must move parts of his body. For me to study myself, can only mean that I am responding to my own responses. The act of studying or classifying is itself a series of movements usually of the muscles of the speech mechanism that have been standardized into such categories as same-different, more-less, visual, auditory, etc. If it were possible for me to achieve a bodily condition in which there were absolutely no effector changes, I should be virtually dead for the time being; certainly I should not be studying myself or anything else. When I study someone else, again I can only record those changes occurring in him which produce changes in me (act on my sense organs). The minuteness of the recorded changes will depend on the acuity of my sense organs supplemented by instrumental aides.

When another studies my behavior he uses mainly his eyes and ears. When I study my behavior the classes of sense organs that are stimulated are more numerous, including the cutaneous, kinesthetic, gustatory, olfactory, static and organic senses. It is to be expected therefore that I can record as occurring in myself types of changes that cannot be detected by another; or to use a popular characterization, that I know more about myself than others know about me, or that my own experiences are richer than my outward behavior will show. No matter how complex and involved human achievements may become they are in the last analysis the functioning of contractile elements in the individual's body.

To take the further step and maintain that some of the changes that I may record are not biophysical changes, assumes that all the principles underlying biophysics are known sufficiently well to justify the introduction of a non-physical or psychical entity. But if the properties of this psychical entity are only negative, that is, non-material, non-neural, non-chemical, etc., nothing is gained, and the principle, viz., that no new factors shall be assumed until established principles have been demonstrated to be inadequate, seems the logical course to follow. The mere fact that human behavior and human achievement seem to conform to some plan or purpose not obviously mechanical in origin, does not in itself jus-

tify the assumption of non-physical causation. At the beginning of the study of man, psychology started out with the prevailing belief that human conduct was teleological and was controlled either by or through a super-being who operated on non-mechanistic principles. When biology began to demonstrate that human activity was largely mechanical or sensori-motor in character, it became necessary to draw the line between mechanical and non-mechanical behavior. This division has been gradually encroaching on the non-mechanical end of the human conduct series. The so-called psychical factors represent a transitional phase between the earlier animism and the recent mechanistic trend.

PART THREE

SPECIFIC RESPONSE CATEGORIES

THE LANGUAGE RESPONSES

CHAPTER XIII

THE LANGUAGE RESPONSES

Manipulating or Handling Responses—Language or Speech Responses—The Acquisition of Language—Learning the Word *Orange*—The Word-Object Learning—Words as Stimuli for Relationships—The Generalizing Function of Language—The Dual Character of the Language Response—Types of Language Reactions—Biosocial Function of Language—Summary.

A comprehensive presentation of the development and function of the many responses which form the elements of human achievement is beyond the scope of this book, but the significance of language is so great and its nature has been so misunderstood that an attempt will be made to present at least the essential principles. When human achievement is regarded as a form of behavior two relatively distinct types of movements may be discriminated: (a) the manipulation or handling response; (b) the language or speech response. Speaking generally, for the average adult human individual every stimulus may release either a *handling* response, a *language* response, or both.

Manipulating or Handling Responses

These responses include most of the movements by which the individual adjusts himself to his environment by the larger bodily movements, such as grasping and handling with hands and feet, running, eating, sleeping, the various reflexes, instincts, and acquired responses insofar as they are not part of the speech mechanism. The postural, accommodatory, and protective types of movement are also to be included under handling responses and particularly that very extensive group which represent the vocational, professional, recreational, and personal activities that are not specifically speech reactions.

Language or Speech Responses

Many of the criticisms against behaviorism are based on the assumption that all behavior must be described in terms of the contractile elements actually involved, and that language as a behavioristic phenomenon must be reduced to its laryngeal or myogenic components. It seems to me that this is a mistake. The essential characteristic in the language reaction is a particular *sound*, a *written* set of characters, a printed symbol, etc. The actual muscles that produce the sounds, characters, or symbols are relatively unimportant. When I respond to the voice of my fellow man I react to the series of sounds that he produces. Neither he nor I need know anything as to

the actual muscle fibers that contracted in producing the sounds. An oral speech reaction is an *inorganic sound,* not a series of muscle contractions, though of course, the contractions are necessary to produce the sound. To be able to discriminate by the aid of precision instruments all the sensori-motor components in uttering a given word, would be of neurological advantage, but from the standpoint of behavior, the mechanism of sound analysis (the ear) is more precise and more convenient than any set of myographic apparatus that has been so far invented. As sounds, it is easy for the individual to discriminate between *hat* and *hot* but to describe the difference in terms of muscle contraction is practically out of the question. To go a step further, the individual's reactions to the sound *there* are different from his reactions to practically the same sound *their* occurring in a different sound complex. The behaviorist is not concerned with determining the exact effectors that function in a given speech reaction; his problem is that of determining how the final result (whether this is a sound, a written word, a bodily movement, a facial expression) acts as a stimulus on others and thus determines the social status of the individual. Two socially equivalent responses may be entirely different from the motor side (the *sound* of a word or the same word *printed*) or they may be identical

from the motor side but different as social stimuli, such as the oral words, *their* and *there.*

The Acquisition of Language

From the sensori-motor side language is a habit or a conditioned reflex which at first is added to some handling response, but subsequently may function independently and with other handling or language responses. The structures most involved in the oral language reactions are: vocal cords, lips, jaw, tongue, palate, pharynx, larynx, and the chest muscles involved in producing pressure in the lungs. From this mechanism are derived many other language variants such as printing, writing, signaling, phonograph, radio, etc.

In *establishing* the oral language reaction, the following elements are involved: (a) The reaching and grasping reflexes by which a child handles and manipulates the objects presented to it, or which come within its sensory range. (b) The vocalizing reflexes through which the child produces all kinds of sounds more or less distributed throughout the waking part of the day. This vocalizing reflex is not an essential part of the manipulating reflexes; it may occur under practically any stimulating conditions, and so far as known is not specific in the sense that the child inherits a mechanism to produce a particular kind of sound.

A child in health and comfortable, plays with his hands, kicks about, and also moves lips, tongue, larynx and chest and thus produces a great many different sounds and sound combinations; not only some of those which are used in his mother tongue but also strange crowing, smacking, and clucking sounds. The sounds produced stimulate the child's own ears and this stimulus occurring together with the other stimuli that are producing the sound leads to a repetition of the sound. The simultaneous occurrence of the sound stimulus of the child's voice and the kinesthetic stimuli from the muscles in the speech mechanism, produce sound combinations of various sorts, some of which because of their greater frequency (as the words of the mother tongue) produce greater sensori-motor modifications than those sound stimuli which are irrelevant.

Learning the Word *Orange*

It is assumed that the child has learned some handling reactions and is playing with an orange and babbling. If the word *orange* is now pronounced by nurse or parent the sound will stimulate the child's ears. Some of the random sounds that the child is making may resemble the sound of the word *orange*. The resemblance need not be at all close. A faint vowel similarity is likely to occur within a reasonable period. While the child is pro-

ducing the sketchy *orange* sound, its own voice acts on its ears and the auditory nervous process that is produced supplements whatever process has released the original sketchy sound. If at about this moment the parent also utters the sound *orange* there will be auditory supplementation of this particular sound stimulus. It is not probable that the child's first attempts will resemble the word *orange* very closely but as the situation continues the child's own sound stimuli produced by its own vocalizing mechanism will resemble some of the sounds produced by the parent. This will lead to a modified response which may produce a sound that may resemble that of the parent still more or it may resemble it less. If less, no progress has been made. If the new sound is more like that of the parent the modification is more likely to become permanent because both stimuli, the parent's sound and the child's own voice, are more alike and whatever stimulus condition is operative in the production of the sound will be supplemented. In addition, if the new sound resembles the parent's sound more than the child's own sound (which probably was not recognized as similar at all by the parent) the new sound of the child may stimulate the parent to produce the word sound more energetically and more intensively. This reacts on the child and as a final result the sensori-motor modifications in the direction of the parent's sound *orange*

are favored and those muscle coordinations by which it is produced are made more permanent than the original random combinations.

All of this is going on together with the visual, tactual, and other stimuli that are releasing handling and manipulating actions. The child's orange *speech* reaction, imperfect as it may be, finally becomes a part of a complex made up of visual, auditory, kinesthetic stimuli, which at any subsequent time are more likely to release the speech reaction *orange*, than any other sound reaction. I do not wish to imply that the sound *orange* has any special affinitative relation to this particular type of stimulation. The situation is merely continued until the word of the mother tongue has become a response to the situation. Learning the *word* orange is thus the same sort of phenomenon as any other learning. It is a supplementary reaction such as touching, rolling, or playing with it. It is only later that the word becomes a symbol or signal or a stimulus for sensori-motor interchangeability between individuals.

The Word-Object Learning

Suppose as one of the manipulating reactions released by the sight of the orange, the child has learned to eat the orange. During the eating, taste, visual, tactual, kinesthetic receptors including those that release the speech mechanism, are all being

stimulated so that after a time any one of these may come to release the speech reaction *orange.* Suppose the orange is out of reach; the visual stimulus alone may release the word *orange,* without the tactual and kinesthetic stimulations from the manipulating movements under which the word was learned. The child's pronunciation of the word *orange* while fixating it, stimulates the parent who may respond by taking up the orange and giving it to the child. If the parent does not, the final reaction of most children (crying) will occur and this is usually a strong enough stimulus for the parent to respond to the child. Assuming that the child is fixating the orange, the parent already having learned the adequate response to the fixating movement, will hand the orange to the child who now begins to play with it or eat it, occasionally repeating the word *orange.* During this occasion the sense organs of the child are being constantly stimulated by what may be called the *breakfast situation.* Certain elements of this situation are constant from day to day,—the sight of the parents, the table appointments, the time of day, etc. The child's verbal orange reaction (along with many others) becomes a part of the breakfast situation. On some later occasion, even though there is no orange on the table, the stimuli that are constant and uniform from day to day in the breakfast situation may release the child's verbal orange reaction.

This does not mean that the child has *perceived* the absence of the orange and is now demanding one. It only means that the child is responding to the breakfast situation as it has responded on numerous previous occasions and that the verbal sound orange may be only one out of hundreds of other sound combinations that the child may produce. However, the sound of the child's word orange *may* stimulate the parent to respond by securing an orange for the child. Sooner or later this will happen but to assume that it happens the *first* time is unnecessary. When the parent does secure an orange after the child has produced the sound of the word, all the conditions will be more favorable for fixing those movements that produce the sound orange, whether those conditions are the presence or the absence of the real orange. So far as the child is concerned the sound of the word releases a 'getting' response in the parent. It is in this sense that the *word* orange may produce a real orange. The fact that the word orange as a sound has no resemblance to the real object of vision, taste, and smell, is no more remarkable than the fact that the child may develop the response of throwing the orange on to the floor. It is only the subsequent social conditions that make the *word* a biosocial response, whereas the response of throwing on the floor does not become socialized.

Words as Stimuli for Relationships

When the parent reacts to the single word orange by getting an orange for the child he is actually bringing about a *relationship*, spatial and perhaps nutritional, between the orange and the child. The child learns to produce these relationships somewhat as follows: The parent reacts to the single word orange as if it were part of the sentence, "I want an orange." He may even supplement the single word *orange* uttered by the child by the phrase "Baby wants an orange" and the verbal phrase "Baby wants ———" is gradually acquired as a stimulus for producing the relationship of bringing some object within handling distance of the child's body. This process of learning is an extension of the principles involved in learning to pronounce the word *orange*. Modern society has developed pedagogical methods by which standardized language reactions are taught so rapidly that the intermediate stages are very short.

It must not be supposed that the parents are passive throughout these stages. Their own behavior is also being modified in the direction of establishing biosocial responses in the child. The child is thus made a part of a biosocial situation which has the effect of emphasizing or intensifying stimuli that are produced by other individuals, until they become more intensive than the stimuli which are genetically or biologically prior to the social stimuli. In this

way the effects of inadequate inherited connections are replaced by more effective biosocial forms of stimulation. When language is learned it becomes a habit, which is at first imperfect, but as learning continues the child is taught to imitate the language structure and grammar of the adults.

The Generalizing Function of Language

Because the word response is independent of the sensory nature of the stimulus, many different stimuli may release the same word reaction. This form of behavior is known as generalization, and the process may be described as the generalizing function of language. As a behavior category generalization is a type of sensori-motor mechanism in which many different receptor patterns representative of many different sensory situations and relations, are connected to the *same* language response and through this common path the individual may react in a specific manner to all the objects, situations, and relations thus connected, even though there is very little sensory similarity between them.

Take for instance the generalized language response of the word *food*. When the word *apple* was being taught as the reaction to the *sight* of an apple, handling reactions such as peeling, eating, hiding, cooking, were also acquired. At a later time

in addition to the name apple another name was taught, that of the word *food;* for the object bread the child acquired the name *bread* but also such handling reactions as toasting, soaking in milk, spreading with butter, and again the name *food* which is also one of the names of the apple; with meat there was acquired the name *meat* and again *food*, plus handling reactions such as boiling, frying; with milk there was the name *milk*, the common name *food*, plus handling reactions of pouring into a glass, drinking, etc. The verbal response *food* is thus a common sensori-motor mechanism which connects the objects apple, bread, milk, with their respective handling reactions of peeling, slicing, boiling, drinking, etc., much more directly than with each other. The speech mechanism that produces the word food thus serves two purposes: (1) The sound of the word *food* may act as a stimulus to *prepare* the individual to react by any one of the food handling reactions of peeling, slicing, boiling, drinking, etc., when a given *class* of non-similar sensory stimuli (foods) are presented. (2) The sight of any *new* object which resembles the edible food objects but for which the individual has not learned a specific handling reaction, may release the reaction *food* and this in turn the repertory of food handling sensori-motor mechanisms so that the new handling reaction which is formed may be developed from those

responses which require least modification and which already represent the biologically most adequate responses.

The generalizing function is thus a neurological net-work of sensori-motor connections through which many dissimilar objects and their specific reactions are interconnected through a common sensori-motor function (the general term) in such a way that those reactions which biosocially belong together are readily made available through a common stimulus and response. Simply stated the generalizing function of language organizes the whole repertory of reactions which the individual possesses into groups and sub-groups which are made available through appropriate language stimuli, without the need of the stimuli from the actual objects or situations. This makes possible an almost unlimited refinement of behavior categories. Such relations and discriminations between objects that are expressed by such terms as acceleration, pitch, irrational number, atomic heat, justice, science, would be impossible without this generalizing function. Generalization from the biosocial standpoint only means that an artificial set of stimuli (words) may release responses that are entirely dissimilar from the original sensory learning conditions.

Mathematical descriptions are so little influenced by the sensori-motor variability between individuals,

that the ideal language for the description of human achievement is mathematics, and the electron-proton conception which has been selected for the analysis of human conduct has been selected because it best adapts itself to mathematical description.

The Dual Character of the Language Response

One property of the language response which is not shared by any other form of sensori-motor mechanism is that of functioning either as a response to a stimulus, or as a stimulus for a response. This dual character fits it particularly well as a means for intercommunication and co-operation. One individual may react to some situation by language, and this serves as stimulus for some other individual to perform the handling reaction for which he is much better prepared. Suppose an individual discovers a house on fire. His own strength would be inadequate to actually accomplish much in putting out the fire, but if he responds to the fire by a verbal response to the proper authorities, say the chief of the fire department, he will accomplish more by a verbal response than by his own physical efforts in putting out the fire. In this way co-operation between individuals may be extended over many individuals and over long intervals of time. Specialization becomes possible to a much greater extent than is developed

by animals and we approach much more closely to the condition of sensori-motor interchangeability between individuals which I have designated as the principle underlying social organization.

It is beyond the scope of this book to consider the genesis of the language responses in great detail. As a matter of fact the psychologists have practically ignored the excellent linguistic researches that have been conducted in the last decade. Language has always been regarded as a "gift" to report the character of so-called mental states, rather than as a form of behavior. However, the writer will try to indicate a few of its social and individual characteristics. Only arbitrary statements can be attempted and the reader is referred to the literature on the subject.

Types of Language Reactions

So far, the language that has been considered is oral language. Other language responses irrespective of national or dialectic characteristics are writing, printing, raised script for the blind, lip movements and finger movements for the deaf, etc. From the various types of language responses we may see that no specific receptors or effectors are essential, but that it is a biosocial response developed from a reciprocal relationship between individuals.

The language responses developed by normal man as forms of behavior for sensori-motor inter-

changeability between individuals possess the following biophysical advantages:

1. An unlimited variety of responses. The English language has about a half-million words, each one of which represents a definite stimulus and a definite reaction. When grammatical structure is considered the variety of possible stimuli is infinite.

2. It is not necessary to see the individual. Oral language signals can be exchanged in the dark or around visual obstructions.

3. The expenditure of muscular and nervous energy is relatively small. It requires less energy to talk than it does to perform handling reactions.

4. Language does not interfere with the handling reactions performed by hands, arms, and legs.

5. The phonetic speech sounds are easily converted into visual speech symbols such as writing and printing and in this form they are permanent and relatively invariable.

6. New signals and code forms are easily developed.

Biosocial Function of Language

The biophysical advantages of the language responses that have been enumerated manifest themselves biosocially as follows:

1. The language responses practically unite all the members of a group into a single sensori-motor organization. The receptors and effectors of any

individual are placed at the disposal of all other individuals and thus a functional or biosocial continuity is established. Anatomical discontinuity, with functional continuity, gives the social organization the equivalent of longer life, greater strength, and greater survival value. Relatively stable inorganic substances may be substituted for the unstable organic compounds. Copper telegraph wires are better than neurons as conductors when individuals at a distance wish to communicate.

2. Language is a means for varying the original inherited and acquired responses. As a biological function language enormously extends the environment and sensory range of the individual and increases the variability of behavior.

3. Language may either be the stimulus for a response or the response to a stimulus. This produces co-operation in the direction of establishing the biosocial and sensori-motor interchangeability between individuals which is at the basis of transportation and industrial organization. Under ideal social conditions this would yield a maximum co-ordination and specialization of labor, and give each individual an opportunity for the maximum development of variety in behavior.

4. The language response as a substitute stimulus for actual objects or situations allows the biosocial reproduction of practically any stimulating conditions

that have ever occurred at any time or place. Through the language records any event may be made available at any time. Language stimuli as simple artificial objects for relations and generalizations facilitate discovery and invention. Personal experimentation is made a continuous process; instead of each individual learning through personal experiment he can start where the preceding experimenter has left off. Through the language records of occurrences individuals may prepare to respond to situations that have not yet occurred.

5. The language reactions as written and printed records, or as the traditions of such relatively permanent institutions as the law and the church make available for nearly every individual's use the very best responses and adjustments that have been invented or discovered. Inadequate adjustments are soon eliminated, and poor inheritance is largely overcome by developing comparative standards by which to measure the effectiveness of the behavior forms, without resort to the ultimate test,—the survival of the fittest.

6. Language may release those responses which have been classified as artistic and esthetic forms of behavior.

Summary

In man, language, because of its permanence as a response and its independence of the nature of the

objects or events for which it is a substitute stimulus (its symbolic character), has made possible the development of generalizations and abstractions which far exceed those of any other animal. It is through the specificity of the response to complex environmental conditions and relations that the individual's effectiveness as a co-operative unit in a social organization is determined and unless these specific motor patterns also act as specific stimuli on others they do not meet the co-operative requirements. Now it is precisely the conventionalized or socialized phase of the discriminative, relational, comparative, etc. form of sensori-motor organization which form as it were, an index of the individual's effectiveness and this index is what we mean by language. For the behaviorist human achievement as represented by the educational, vocational, administrative, recreational, and personal activities of individuals is the result of sensori-motor mechanisms which belong to various categories of responses which genetically trace back to environmental conditions which now no longer exist.

THINKING

CHAPTER XIV

THINKING

THE STIMULATING CONDITIONS—THE INTERVAL BETWEEN STIMULUS AND RESPONSE: *The Biophysical Response, The Implicit Response, Specificity of Movements* —THE FINAL BIOSOCIAL BEHAVIOR.

WHAT IS THINKING?

THINKING AS BEHAVIOR—PROBLEM-SOLUTION BEHAVIOR: *The Problem, Intermediate Conditions, The Solution Responses*—THE FORM OF THE SOLUTION RESPONSE—THINKING PRIMARILY BIOSOCIAL BEHAVIOR.

THE term thinking is not understood in the same way by all investigators and it might be well to illustrate what the writer regards as a complete act of thinking.

Imagine two men who have never seen each other, one of whom has been reared and trained in England, the other in Germany. They are not familiar with each other's language, nor has their training as measured by text-books, teachers, or manual skill been similar. In fact, suppose their past behavior has been as dissimilar as possible to meet the conditions imposed by the problem. Both men are required to design a tachistoscope for a special purpose. After some time they present designs and specifica-

tions which they turn over to their mechanics. At the end of a reasonable period the mechanics submit their constructions, and we will suppose the two pieces of apparatus are found to perform equally well what was demanded of them under the original specification. The test of the equivalence of the two pieces of apparatus is given by the extent to which they may be interchanged for each other. Our question is to determine to what extent the *thoughts* of these two designers were similar, it being assumed that this designing activity required so-called thinking somewhere in the series. Can we say for instance that when two men start out with the stimulating conditions equivalent for both and work for a time, and the results of their efforts (the completed apparatus) are functionally the same, that their thoughts were the same? The answer to this question will require an analysis of the situation and to simplify the analysis we shall divide the situation into three parts: (1) The stimulating conditions which include the instructions that are given to the designers; (2) The interval between the presentation of the stimulus and the beginning of the movements and processes which produce the completed design; (3) The final biosocial behavior consisting of the movements of making the final drawings, sketches, or oral instructions to the mechanics, and the actions of the mechanics in constructing the tachistoscopes.

The Stimulating Conditions

It is clear that the physical stimuli in which the problem was presented could not have been identical for both men. To the Englishman the problem must be presented in English, and to the German in his own language. Nor is it necessary to use the same physical form of stimulation. The problem may be presented orally, as a pencil sketch, as a photograph, in script, printing or typewriting, or in many other physical variants. It is not even necessary that both men be stimulated by the same form. For one designer the mathematical conditions may be stated, for the other only the practical conditions.

The Interval Between the Stimulus and the Response

This interval is filled with various kinds of activities internal and external which seem to be preparatory in character.[1]

[1] When the writer uses such terms as imagery or other subjective terms he does this to show just what phase of the traditional concept of thinking he is describing. For the behaviorist imagery is only a form of implicit behavior, a sensori-motor activity of a specific type, and never a non-physiological or non-material entity. As much as possible the writer will try to qualify his use of subjective terms as he uses them. One might ask, why use the subjective terms at all? The only answer is that if we are going to try to discuss thinking we must use the word, and if in the historical development of the term thinking, the term imagery has also played a prominent part, I do not see how we can help using the term. The alternative method of constantly qualifying the subjective terms by such devices as, so-called imagery, consciousness so-called, alleged mental state, etc., results in a literary style which grates even on the writer's nerves, though he is not at all hypersensitive.

In the analysis of the interval between the stimulus and the response we shall consider, (a) the biophysical responses, (b) the implicit responses, (c) the specificity of the biophysical and implicit reaction.

The Biophysical Response—Observing the two men during the interval will reveal a series of movements that are very difficult to classify: Running fingers through the hair, drumming on the table, frequent changes of posture, walking around the room, looking out of the window, muttering, making pencil sketches with frequent erasing, playing with paper knife, making calculations, verbal fragments, talking out loud, tapping with foot and many other reactions which may be described as movements of restlessness, or of preoccupation. In addition, there are definitely co-ordinated activities such as consulting reference works, catalogs, lists of supplies, and tables of dimensions or calculations.

During this whole interval it may happen that no two actions of the men are identical. Both may be described as preoccupied but the actual movements may be entirely dissimilar for both men. There is apparently nothing in the biophysical behavior of the two men which may be regarded as an *essential* antecedent for designing this particular tachistoscope. That is to say, a similar piece of apparatus might have been designed by a third individual without any of

these movements. It may be that these apparently irrelevant movements were essential antecedents for the particular individual who made them, for completing the design just as it was completed, but a different set of apparently irrelevant movements might have produced a better or a poorer design.

The Implicit Response—In addition to the observable movements, there are many that can not be detected by an observer. Some of these movements may be reported by the designers as imagery, others may be secured by precision measurements on respiration, blood pressure, tonicity, pulse, psychogalvanic records, etc.

Suppose the imagery consists of visual images of parts of the anticipated apparatus, of the shape of a cam or wheel which gives a particular movement, a rough outline of an electrical contact arrangement, the relative sizes of two gears, language and other symbolic imagery, images of the teacher in mathematics or physics, of the laboratory work shop, lathe, tools, imagery of the tasks that the apparatus is to perform and the order in which certain operations must occur. Also there may be a great amount of irrelevant imagery,—an auditory image of music, of some one's voice, of the sound of machinery and registering apparatus, visual images of past reactions to various scenes in college, family, childhood, etc. The possibilities are infinite. No attempt is made to as-

sign these images to one or the other of the two men. Either may have had any image and considering their different biosocial antecedents it is not likely that they would have many images in common.

On the neurological side this difference in imagery means that the sensori-motor net-work is not the same in both men. It may be affirmed that the nervous processes have occurred at a certain cortical level or in a particular association center, and that during the interval most of the neural activity of both men is restricted to this level even though the actual configurations of the separate net-works are not the same. We may say then that to design a piece of apparatus like the one indicated, the essential condition is that the neural activity preceding the recording of the design must occur at a particular cortical level.[2]

This, however, does not explain the biosocial equivalence of the two pieces of apparatus. Even if only one man completes his design and the other fails, the neural activity of both is probably at the *same* level. The only way of judging the level or

[2] The term cortical level is to be taken in a figurative sense. We may differentiate a spinal level, cerebellar level, cerebral level, in anatomical terms. But the term level as here used refers more to the number of sensory and motor neurons that are interconnected through one connecting neuron or association fiber. The higher the level of a given connecting neuron the greater the number of sensory and motor neurons that are interconnected. It should also be remembered that the term level has significance only for the connecting neurons. Sensory and motor neurons have no level.

center at which neural activity is occurring is by the character of the final biosocial response. While it may be correct to say that neural activity at a given level is necessary to complete the design, the reverse, that neural activity at this level will *always* produce the design, is not true, nor can it be said that if one design is a failure, that the antecedent neural activity occurred at a lower level.

Neural activity at a given level or particular brain center may be an essential antecedent for producing a particular design, but it is also the essential antecedent for so many other designs, including even a *wrong* design of the apparatus, that it cannot be used to explain how these two men are able to design two pieces of apparatus that are functionally identical. We may conclude then that even if it can be established that the central neural processes are occurring at the same level in both men, the differences in imagery or the implicit rseponses do not reveal specific processes that may be regarded as the *essential* antecedents for the designing activity.

The respiration, blood pressure, tonicity, pulse, and psycho-galvanic records of the two designers may be even less similar. The precision instruments will record little more than the degree of restlessness or preoccupation. No one can read directly from the records whether the men are going to be successful or unsuccessful in their designs. In other

words the metabolic rate and tonicity of the muscles are not diagnostic of success or failure in designing a tachistoscope.

Specificity of the Movements—It does not seem then that either the biophysical or the implicit activity that occurs during the interval between the stimulus and the completed design needs to be filled in by any specific form of movement. Whatever form occurs may be entirely different for the two individuals and yet the final designs may or may not meet the biosocial requirements.

On the other hand all or the greater part of the activity which occurs during the interval is essential for the particular individual, and the design will not be the same if this preliminary activity is disturbed. So far as the particular individual is concerned every step, from the time the stimulus is presented to the time the design is completed, may be regarded as an essential antecedent. The justification for this assumption is difficult to produce directly. But suppose while both of the men are working, one of them receives a telegram telling him that his family has had a serious accident and for him to come at once. It is very probable that the distraction will be such that he is unable to complete the design although all the evidence may show that he would have finished it within a few moments had not the telegram arrived. While the movements that precede a

given final action are necessary antecedents for the final action, these movements need not be identical for two individuals who are working toward a given biosocial result.

The Final Biosocial Behavior

We have assumed that the completed designs of both men are biosocially equivalent because the mechanics actually constructed two pieces of apparatus which might have been used interchangeably for the purpose for which they were designed. This does not mean that both designs are physically identical. One design may be an elaborate mechanical drawing of all the parts, with top, side, and end elevations, all dimensions carefully marked; the other design may be merely a rough pencil sketch with some important measurements and the machining processes indicated. Again, the design may be a series of oral instructions, the mechanic himself making the rough sketch. The exact form of the design may vary within wide limits depending on the character of the mechanic whom the designer selects. One mechanic may construct his apparatus out of odds and ends in the laboratory. The other mechanic may mill and lathe his tachistoscope out of blank stock. None of the movements of the two mechanics need be identical. Even the finished tachistoscopes may exhibit no structural similarity.

In review we may say that for the two designers, the stimuli were different, the movements between stimulus and the biosocial response (the designs) were different. For the mechanics the designs were different, the movements in building the apparatus were different, the two sets of apparatus are physically different. Yet, both pieces of apparatus are *biosocially equivalent.*

What is Thinking

The designers in the preceding section must in some sense, have had the *same* thoughts to be able to prepare designs which resulted in biosocially equivalent pieces of apparatus. It is certain that this *sameness* need not have been one of biophysically equivalent stimuli, imagery, cortical processes, or any movements or processes whatsoever. On the other hand, to say that their thoughts are different, leaves unexplained how the two pieces of apparatus can be biosocially equivalent. Evidently if the term thinking is to be used in more than a very vague sense an attempt should be made to delimit the facts which the term is to include.

If thinking is defined according to the kinds of processes that intervene between the problem stimulus and the biosocially acceptable *solution* response (the finished tachistoscopes) then having similar thoughts does not mean having similar movements,

similar imagery, similar subvocal reactions, similar organic reactions. It is usually held that in normal effective thinking, language is essential because of its symbolic character, and hence the subvocal and implicit language reactions may be regarded as essential but this cannot mean that the identical effectors must function. To affirm that two persons speaking a different language cannot think alike is not the sense in which the term thinking is used. The translation of a text-book from one language to another presupposes that the thoughts expressed in the original may be translated into another language, although there may be some doubt as to how perfectly this can be done. If we maintain that persons speaking different languages may think alike (the more general assumption) and persist in defining thinking on the basis of the similarity of the implicit processes intermediate between the problem stimulus and the solution response, then we must introduce a symbolic similarity. We must say that while a German does not have the same subvocal processes as the Englishman, the processes may *mean* the same thing. However, the test of symbolic similarity can only be measured by biosocial equivalence, and we have excluded this because it is not an intermediate process between the problem stimulus and the solution response. There is no way of measuring the

symbolic similarity of the intermediate processes, from the processes themselves.

If thinking is defined according to the cerebral level of the neural processes and synaptic connections we may have a test for thinking in general but in this sense thinking is little more than a behavior category. We might find that one solution response had its antecedent nervous processes in one net-work, while a different solution response passed through a different net-work, both net-works however being on the same level. To establish such levels in the living individual is impossible at present. The only practical test for similarity between neural net-works must again be based on the biosocial character of the individual's behavior. Even if we extend our conception of the neural net-work and require that thoughts to be designated as similar, must include the same receptors and effectors, we never get beyond a biophysical equivalence, for which the term thinking is unnecessary. To say however that the *same* thoughts can occur in different net-works is contradictory.

Apparently the only practical test for determining cortical level is that of designating the degree of generalization of the verbal biosocial response. Thus an image of an apple is less general than the verbal image food, and food is less general than the term life, and it in turn is less general than the term uni-

verse. But for the child who has just learned the word universe, is this as general as for the astronomer for whom nearly every reaction is associated with the term? Furthermore, the "generalization test" will again exclude the possibility of two individuals speaking different languages, having the same thoughts unless we again attempt to establish a symbolic equivalence. However, just as we found that symbolically similar imaginal processes can only be described as similar with reference to the biosocial character of the solution response, symbolically similar neural and synaptic net-works must also be equated through the biosocial nature of the solution response. The writer has used the neural net-work principle because it is readily visualized. The same arguments against a central faculty, could of course be directed against any other central neural factors such as cortical centers, resistance gradients, subconscious processes, etc.

All three of the methods of defining thinking (type of imagery, cortical level, character of sensorimotor net-work) owe their origin to the traditional conception that thought or thinking is a faculty which in some way scrutinizes and directs the nervous processes so as to produce a given uniformity. For such a faculty it would be an easy thing to recognize that the sensory processes for the words *horse*, *pferd*, *cheval*, are biosocially equivalent even though biophysically incommensurate. However, science re-

quires that the antecedents of the faculty shall also be isolated, and this leaves the problem where it was at the beginning.

Thinking as Behavior

If thinking is defined according to the biosocial character of the responses that are the solution to the problem stimulus, two thoughts are similar when the solution responses meet similar biosocial requirements. Suppose we review the designing illustration in synoptic form. The Englishman has the problem presented to him in English, the German in German. Hence the stimuli are *not* biophysically equal. During the interval between stimulus and response, the Englishman's central and organic processes are effects of English methods, and for the German, the effects of German methods. Again there is *no* biophysical indentity. The Englishman prepares a design (the solution response) the *English* way, the German prepares the design the *German* way. These solution responses are *not* biophysically identical. The German's design is given to a German mechanic who assembles the apparatus out of suitable odds and ends in the laboratory; the Englishman's design is given to an English mechanic who constructs the apparatus from new material. Hence, the building reactions of the mechanics are *not* biophysically commensurate. The tachistoscopes

are taken by an American graduate student who uses them *interchangeably* and for whom they are *equivalent* in the sense that whichever tachistoscope is used, the behavior of the American (as experimenter) does not vary according to which tachistoscope is being used. In fact conditions could easily be arranged so that the experimenter would not know which tachistoscope is in series.

In conclusion we can generalize our designing problem into three relatively distinct parts: (a) a stimulating condition of the *problem* type, (b) followed by variable movements, (c) a response regarded as the biosocial solution to the problem stimulus. From the standpoint of the behaviorist, thinking reduces itself to what we may designate as the *problem-solution* form of behavior.

Problem-Solution Behavior

In undertaking the behavioristic analysis of the illustration used, it is necessary to refer to biosocial conditions which had been already well established before the designers were born.

The Problem—For the problem stimulus we presented instructions to design a piece of apparatus. Suppose we consider the conditions under which two stimuli are said to be equivalent. This immediately introduces the biosocial aspect. Stimuli are equivalent when they are the antecedents of equivalent co-

operative forms of behavior. An oral stimulus may be the biosocial equivalent of a written stimulus. Biosocial equivalence has a long history of development. During this development certain pedagogical principles were established, dictionaries were developed, some individuals learned more than one language and then compiled transfer dictionaries and grammars, which in time became part of the educational system. The fact that oral sounds and written symbols are equivalent as stimuli is part of the training of a child,—that is, the child is *taught* to respond in the same way to an oral word as to the (same) written word. For a given response there are now two physically different stimuli (sound and sight). This fact is called literacy.

Every stimulus that acts on an individual is the beginning of a series of stimuli and responses of indefinite extension. The stimulus releases a response, the response changes the stimulating conditions, these in turn release other responses, which in turn again modify the stimulus, *ad infinitum.* In ordinary life every stimulus is followed by a never ending series of stimuli and responses all causally related in a biophysical manner, but progressing toward a biosocial or co-operative terminus. The individual stimulus-response series is constantly being *standardized* by the teacher, if the child is in school, and by parents, books, colleagues, if the individual is out of the

school environment. As a result, the biosocial stimulating conditions under which we live establish conventionalized and standardized responses. This is a continuous process, and our responses to stimuli are constantly being supplemented by more biosocial responses. As a result there are established in the individual many different behavior series which are more or less common to many members of the community. Some of these series may be very long. Suppose we ask, What is the square root of 39 to the fifteenth power? This is the stimulus for a large number of calculating reactions. It is a stimulus that determines the directions of the responses that are to follow and also determines the end point of the behavior series. The end point or last response is given a special name and is called *solution.* In the square root problem it is clear that we are dealing with a biosocial stimulus-response convention which must *first* be *acquired* before the problem can be solved or before *thinking* can take place.

Intermediate Conditions—The responses must also be learned in a specific order to obtain the final *correct answer.* Further, more than one series of responses will terminate in the correct answer, or the biosocially adequate response. Thus the different arithmetical and manual methods, logarithms, slide rule, adding machine, calculating machine, tables, etc., represent different intermediate response series,

but they all terminate in that response which has been established as the accepted place to stop the calculating reactions.

From the standpoint of behavior a problem is a stimulus that starts a series of responses for which there may or may not be some biosocial terminal response. The intermediate movements may be acquired early in life and if used continually many unessential movements and processes are eliminated so that only those fragments remain which are the *essential* antecedent movements for the terminal response. In fact the intermediate response series may lose its overt character altogether so that an observer may be unable to describe it and even the individual himself may be able to discriminate only a few apparently irrelevant fragments. This is the sort of thinking called *doing the sums in one's head.* But the acquisition of the series in the first place (as an educational process) is the essential step in solving the problem.

The fragmentary movements that remain after long practice and which are actually the only essential antecedents to the solution response, are not acquired directly. They differ from one individual to another and represent a residuum of interacting sensorimotor processes that get their character from the behavior life history of the individual. Many of the intermediate responses, especially where the series is

long, may themselves become highly co-ordinated and socialized, for instance, looking up references, interviewing other individuals, the use of particular methods of analysis, etc. Such intermediate series may become very numerous and may be segments of many relatively independent series. Our language generalizations form the most conspicuous examples. Many different stimuli and many different responses become neurally adjacent. No matter how different two problem-solution forms may be when originally acquired, they become more similar to each other as the unnecessary parts of different responses drop off and as the language generalizations become more inclusive. The more similar they become the more likely are they to function together when a problem stimulus occurs which only partly resembles any of the original problems. Through intermediate conditions such as interaction between a number of reduced series, the length of the original series, the extent of reduction that has taken place, distractions and interruptions, the new solution response for a problem may be markedly changed. It is important to urge that the intermediate processes are not spontaneous. Often their origin cannot be determined but they are nevertheless the results of conditions that have been operative throughout the life of the individual. It is just as futile to expect an individual to solve a problem for which there is no sensori-motor

preparation as to speak a language which he has not learned.

The Solution Responses—The nature of the end result in the problem-solution behavior depends on the interaction of a number of reduced or fragmentary behavior series. The way in which any original series is learned is important. The manner of its reduction is also important. For many of the important biosocial responses a more or less effective training system has been developed. While a child is learning to extract the square root, one method for him to derive the correct biosocial response is to have some one solve it for him. When the teacher learns this is being done he interpolates other stimuli which modify the intermediate responses so that the child learns how to extract the square root himself, and so that when the stimulus for extracting the square root occurs under such conditions where help is not available, the child is nevertheless able to respond adequately. As soon however as square-root tables become generally available their use is encouraged although in substance this is the same thing as having the parent solve the problem. The teacher may also insist on the child's learning to extract the square root because it is an essential step in some subsequent series, say extracting the *cube* root. The point to be emphasized is that *thinking* begins with education and is largely a matter of teaching many standardized

or conventionalized response series which have been found to be useful in meeting new biosocial conditions. Of such series, arithmetic or mathematics is pre-eminent because of the specificity of the problem stimulus and the solution response. The solution response for a given individual derives its biosocial effectiveness from the totality of the previous training and from the properties of the nervous system. Training in logic derives its effectiveness from the fact that as a method it converts vague problems and solutions into a serial order in which the terminal response is specific.

The Form of the Solution Response

Every solution response may be expressed in many biophysical forms, varying from the manual movements of actually constructing the tachistoscopes which we have used as an illustration, to drawings, descriptions, blue prints, written specifications, etc. All of these through many years of development have become biosocially conventionalized, and methods have been established by which the conventions are taught to individuals. In general every form of intercommunication has a number of alternatives which are learned by all individuals of the same social status. When for instance it is said that there is only one correct solution to a problem stimulus, this refers to the biosocial response, but every bio-

social response exists in a number of biophysical variants, more or less interchangeable to meet specific cooperative requirements.

Thinking Primarily Biosocial Behavior

The popular conception of thinking is that it is a form of self-activity. The problem stimulus is supposed to arouse some dormant thought force or thinking faculty which classifies the stimuli and selects some solution to the problem, by applying the rules of logic and then sends this solution out to be *expressed* in the responses of the individual. If the solution happens to be wrong more often than right, the individual is unfortunate in either being awarded a poor mind or having lost control over it. This conception of spontaneity pervades even the philosophic writings.

From the behavior point of view thinking is a form of behavior highly conventionalized, made up of very complex response series which are in process of formation throughout the life of the individual and throughout the history of the race. The interval between the problem-stimulus and the solution response is a latent period, not a judicial interval. All the sensori-motor processes that occur have been established long before the particular problem stimulus occurred. The interval is only the duration aspect of these processes. The final solution response also

is merely the end result of the unlimited sensorimotor processes as modified by training, environment, and inheritance throughout the life of the individual. Thinking is a form of behavior, standardized and conventionalized, and typified by a problem stimulus and a solution response. The same forces are operative in thinking as in any other form of behavior. Thinking is a stimulus-response relation, but so is every other form of human behavior.

Professor Warren ('22*a*) has raised the question as to the behavioristic nature of 'thinking.' He states the problem in this form: "Is thinking essentially an *effector* phenomenon, or is it essentially a neural phenomenon? We do not know. The behaviorists believe that thinking is essentially an incipient or implicit operation of the muscles or glands. The introspectionists believe it to be essentially an operation of the central nervous system" (p. 482). It seems to me that Warren has omitted what I have designated as the biosocial phase of the response. Biophysically, thinking is probably both central and effector, but this is true of all responses, and if certain relations between sensory, central, and effector processes are of sufficient biosocial value to be grouped into a special category to which the name of thinking shall be given, our problem is that of designating what these relationships shall be, holding before us the historical and practical significance of this term.

We find three relatively characteristic conditions: (a) a stimulus of the *problem* type, (b) an *interval* of longer or shorter duration, (c) a *solution* response. The traditional conception of thinking seems to imply that the thinker must be able to describe some earlier similar condition (as imagery) during the *interval* but he must not *actually* describe it. The *solution* is a response which meets some biosocial condition that has already been standardized or that is on the way toward becoming a standardized response to this type of stimulus. The specific character of thinking may thus be regarded as the occurrence of an implicit response to a problem stimulus, in which the self-observer is able to (but does not) describe fragments of earlier but similar stimulating conditions, and responds overtly by some conventionalized response which is, or becomes, the solution. Any attempt to actually enumerate and isolate even the effector processes, in any problem-solution behavior category is hopeless. To work toward an enumeration or description of the *central* neural processes as Warren seems to require, is certainly beyond any practical range. But suppose we could localize every effector that functioned and designate the intensity of its functioning; enumerate every neural element in the central nervous operation and its quantitative characteristics; could we from such data alone develop a classification which would conform to the

historical meaning of the term thinking? Of course this is not essential, but then we may ask, why use the term at all? Are we not insisting that because faculty psychology created a faculty of thinking, there must be an equally specific sensori-motor correlate?

From the behaviorist point of view, the whole series of problems usually covered by 'the higher thought processes' reduce themselves to residual effects of acquired behavior series that have become so fragmentary that the responses are largely implicit. Certainly there is no super-physiological process that may be regarded as essential to thought. When we shall have determined the biophysical and biosocial conditions under which such a response as that of 'acceleration' has been *acquired* the problem of "thinking" will be replaced by other classifications.

DESIRE, PURPOSE, VOLITION

CHAPTER XV

DESIRE, PURPOSE, VOLITION

DESIRE

The Genesis of Desire Illustrated—Biophysical and Biosocial Steps in the Development of Desire: *At Ease, Snuggling, Crying and Mother Responses*—Readjustment—The Desire to be Taken Up—The Adult Desires.

The Genesis of Desire Illustrated

Consider the situation in which a child is said to have learned to cry so that it will be *taken up* and carried about by an adult. Suppose the infant to be lying in its crib cooing, smiling, gurgling; mildly active with voice, arms, legs; registering what the mother would call contentment. In the course of these movements a pin or other object stimulates pain receptors. The gurgling and smiling stop, the movements become more energetic and jerky, the cooing is replaced by crying. The crying stimulates the nurse or mother who responds by taking up the child and removing the source of the pain stimulation. The child stops crying, is placed back in the crib and is again 'contented.' This may happen a number of times but after a time when the child is put back into the crib it immediately begins to cry again, even

though the pin has been removed. The crying continues until the child is again taken up. This also may be repeated a number of times. The mother finally concludes that 'nothing is hurting the little darling; he is crying because he *wants* to be taken up.' The act of crying now is said to have a new *meaning* for the child. It has become a *purposive* act, a *means to an end.* The child is said to have an original *desire* to be *taken up* and has now learned that if it cries someone will take it up and remove the tedium of the crib or satisfy the gregarious instinct or what not. In the popular sense the development of the desire (to be taken up) appears to be a sort of longing of the body for certain conditions (companionship) and this longing has the power of fulfilling itself indirectly (through crying). To understand the development of this so-called desire a biophysical and biosocial analysis of the different stages is necessary.

Biophysical and Biosocial Steps in the Development of Desire

At Ease Response—The infant in normal health and physiologically comfortable, and lying in his crib, responds to the sights, sounds, and pressures of his surroundings, and to many internal stimuli by kicking, waving arms, moving eyes and head, cooing, gurgling, smiling. We will call this the condition

of the child *at ease.* From the physiological side this means that the total situation is such that the metabolic conditions are at an optimum and all the neuro-muscular processes that are occurring are supplementary to each other in maintaining this physiological or metabolic optimum.

Snuggling—To the sound or sight of the mother, the child may respond by smiling, smacking lips, gurgling, snuggling. This type of response we will simply call *snuggling.*

Crying—If a pin or other object acts on the cutaneous pain receptors the nervous processes from the pain receptors release the withdrawing reflexes, stronger kicking, slashing of the arms, puckering of the mouth muscles, wrinkling of the forehead, tears, and the type of vocalization known as the pain cry. These movements will be simply called *crying.*

Mother—The response of the mother to the child's pain cry is that of moving toward the child, picking it up, examining it, fondling, handling and speaking to it, until the crying stops. The child responds to this form of stimulation by snuggling.

Suppose we consider what will happen under a serial repetition of these conditions. While the child is *at ease* a pin suddenly pricks it. Its sensori-motor system is so organized that the *crying* reaction is released while the *at ease* response and the *at ease*

stimuli are occurring. When the pain stimulus acts, the *at ease* response is replaced by crying. This crying reaction is not to be regarded as a *protest* reaction. It is merely a reflex and automatic reaction to a pin prick just as the *at ease* reaction is the reflex and automatic response to the at ease stimuli. Both the *crying* reaction and the *at ease* reaction can only be explained phylogenetically, not as teleological adaptations of either child or parent. The child's cry stimulates the mother who moves toward the child, picks it up and examines it. In addition to the pin prick the child is now stimulated by the sight of the mother, the sound of her voice, the pressure of her hands in fondling, and these occur practically simultaneously with pain stimulation of the pin. If the pain stimulus is the stronger, the normal mother reaction of *snuggling* does not occur. On the contrary the mother stimulus may actually supplement the pain stimulus so that the *crying* may be intensified. When the child is taken up and examined the pain stimulus stops (assuming the mother has found and removed the pin). Now the normal *mother* stimulus may become effective and release the *snuggling* response. Since, however, the mother stimulus and the crying stimuli have occurred together, new neural modifications are taking place so that in the future the *mother* stimulus may become an adequate stimulus for crying even though originally it was the ade-

quate stimulus for snuggling. This may happen in this way.

During and after the crying, the mother stimulus is intensified by the actions of the mother. She *makes more* over the *hurt* child than under the normal feeding or routine conditions. Consequently the snuggling reactions that follow after crying are re-enforced as compared with normal snuggling. The close temporal proximity between intensive crying and intensive snuggling will bring these reactions functionally closer together. The total number of stimuli preceding both responses will become greater and hence the number of antecedent stimulus conditions that may release both reactions becomes greater. Some of these stimuli may actually be the ones which originally and by themselves would have released only the *at ease* response.

Readjustment

Up to this point we may say that the stimulating conditions we have been considering have modified the infant's nervous system in such a way that (1) the *snuggling* response occurs with weaker and with a greater variety of stimuli than originally and (2) the *crying* response has been shifted functionally close to the snuggling response in that some of the stimuli for snuggling may release crying. In this there is nothing non-mechanical. The variation fol-

lows as a direct consequence from the way in which the stimuli followed each other, and the way the nervous processes that were released interacted in modifying the nervous system.

At some later time, the infant is again placed in the crib under the stimulus conditions that release the *at ease* reaction. The stimulating conditions may be exactly the same as originally but the sensori-motor system of the child is *not* the same. The preceding conditions have modified the nervous system of the infant in such a way that the *crying* and *snuggling* reactions will occur under weaker and under a greater variety of stimuli. Further, the strong snuggling responses of the child have also modified the nervous system of the mother so that in the future she responds more promptly and to a weaker cry. There is a biosocial 'getting together,' as it were, of child and mother. The child cries more easily and the mother reacts more promptly to the cry. The crying response is now not only released by a pin prick, but by loud sounds, hunger, accidental bumps, internal stimuli, mere duration, etc. Consequently, the total conditions are such as to multiply the stimulating conditions which will release crying, and reduce the stimulating conditions that release the *at ease* movements.

In the future an actual pin prick may not be necessary to release crying. The *sound* of the mother

in another room may be sufficient and if crying occurs it stimulates the mother more strongly than before. She comes hurriedly, takes up the child. The child reacts by snuggling. The mother hunts for the pin which she believes to be the cause of the crying. She, of course, cannot find it because in this instance the *sound* of the mother in another room was the stimulus for crying. The *sight* of the mother now releases strong snuggling. The mother has not been trained to make a behavioristic analysis. She *rationalizes* somewhat as follows: 'Baby wants (desires) mamma. Baby doesn't know how to call mamma. Baby remembers that mamma came yesterday when it cried because a pin stuck it. Baby says to himself,—why wait for a pin? I will cry without the pin (means to an end), then mamma will come (purpose)'. Actually of course it is the mother who is supplying the purposive or meaning element.

The Desire to be 'Taken Up'

The actual neural changes in the infant may be described as follows: (a) the crying is now released by two types of stimuli, the pin prick and the sound of the mother in another room; (b) the *snuggling* reaction has been *strengthened;* (c) the child and mother have become stronger stimuli for each other and this is the beginning (for the child) of the biosocial response series. These modifications of the

child's behavior mechanism may be given (by adults) all kinds of interpretations: the actions are purposive, means to an end, the child is beginning to love its mother, it desires the company of adults, its social nature is manifesting itself, it is growing intelligent, it is developing a sense of values, it has developed the *desire* to be taken up. From the standpoint of the behaviorist nothing has occurred but a variation in the response mechanisms of both child and mother in the direction of sensori-motor interchangeability between mother and child. The mother's muscles extend the sensory range of the child, visually, cutaneously, auditorially, etc.; the child's differential crying extends the sensory range of the mother as a symptom or signal of the state of the child's well-being.

The Adult Desires

If the simple *desire to be taken up* is found to be such a complex sensori-motor condition, desires in the adult are still more difficult to trace to their earlier antecedents. As soon as language is acquired the child is subjected to such a complexity of highly developed biosocial stimuli that a linguistic or social analysis becomes necessary. Adults have developed the habit of imitating the actions of other individuals belonging to their own social status. This imitation includes not only separate actions but whole be-

havior series involving long periods of time in their acquisition. Very frequently such a behavior series cannot be consummated for the lack of the proper stimuli, lack of money perhaps. The order in which the stages are acquired may thus be interrupted and when the individual himself responds to the causes of the interruption this response is called an expression of a desire or want. Desire from the behavior side is merely a response to the responses which lack certain stimulating conditions which either have not yet appeared or which may never appear.

The behavior situation is this: the individual is stimulated by an object or the action of some other member of his group. He also discriminates that the essential conditions which precede the acquisition of the object or behavior, will not occur unless another response series (earning money) is performed by him. The individual instead of responding in a way to acquire the object, responds to the absence of one of the essential antecedent stimulating conditions. Thus the *desire* to own a home is a stimulus-response relation in which (1) the adequate stimulus (enough money) for releasing the specific response (buying a particular house) is absent; (2) many *inadequate* stimuli (sight of friends in their own homes) that would release preparatory (buying) responses, are present; but (3) the adequate stimulus (enough money) being absent, the adequate response

(buying) does not occur and the behavior series of *buying a home* is incomplete, and the total sensorimotor condition is called a *desire.*

PURPOSE

An Analogy of Purposive Activity—Purposive Behavior—The Analysis of Purposive Behavior.

From the behaviorist's point of view, purpose or purposive behavior refers to the fact that in addition to multiplicity and variety there is also an organization between the various response series belonging to a given individual, which conforms to a traditional or conventional sequence.

An Analogy of Purposive Activity

We may best visualize the relationship between the responses that make up the so-called purposive behavior category by the rain-drop analogy. We may start with the assumption that every drop of rain in some way or other gets to the ocean. It may fall directly from the cloud into the ocean, or by sinking into the ground at some inland point, may be delayed for centuries before finding its way into the spring, brook, or river, that finally carries it to the ocean. Anthropomorphizing this condition, we may say that it is the *purpose* of every drop of rain to get to the ocean. Of course, this only means that virtually every drop *does* get there eventually. How

it gets there depends upon where it falls. Falling from the cloud it may strike the leaf of a tree, and drop from one leaf to another until it reaches the ground. From here it may pass under or on the surface of the soil to a rill, then to a brook, river, and finally to the sea. Each stage, each fall from one leaf to the next, may be designated as a *means* toward the final end, the sea, and a number of the intermediate stages may be grouped together and the terminal stage designated as the purpose of the antecedent stages. Of the thousands of drops on the tree, no two will reach the ground in precisely the same physical manner, but each drop has achieved its aim (of reaching the ground) and the diverse steps for each drop will be an *essential* step (means) for the particular drop, not only for the partial purpose of getting to the ground but for the ultimate purpose of getting to the ocean.

Human behavior is merely a complication of the same factors. Instead of only a few physical forces such as gravity, temperature, humidity, surface tension, friction, that act on the drop of rain, the stimuli which act on the sensori-motor system of man are much more numerous. Instead of the relatively stable internal composition of the drop of water which is only modified by a few substances which are dissolved or absorbed by it in its passage, man's internal composition is modified by every

stimulus that acts upon the sensori-motor mechanism and by every metabolic change occurring within the body. Instead of such a simple ultimate purpose as that of reaching the sea, for man no generally acceptable ultimate aim has been developed by science. Man's behavior must still be classified on the basis of partial purposes. At any given time in the life of the individual, the actions may be directed to the partial aim of securing food or clothing, securing an education, getting married, paying debts, making investments, etc. All of these are much more complex movements than those of the rain-drop, but they resemble the partial purpose of the rain drop in that any given response series (getting married for instance) belongs to some more or less clearly defined behavior category representing some biosocial status, even though the specific biophysical responses are not the same for any two individuals.

The various steps by which the drop of rain reaches the ocean are called mechanical (not purposive) because it is possible, at least hypothetically to describe quantitatively and qualitatively all the movements in a particular rain-drop from the time it left the cloud to the moment it reached the sea. If we assume for instance that a given rain-drop left a trace of its path, a physicist could from his knowledge of the law of gravitation and the properties of liquids, calculate the mechanical forces that were

operative. A man's series of actions in securing his food are called purposive (non-mechanical) because even if all of his movements were kymographed neither he nor anyone else could describe quantitatively and qualitatively all the mechanical forces which were the *essential* antecedents of food-getting. Much less is the individual able to describe the extent to which his actions form a partial purpose in his own life history or in the life history of his group, state, nation, or humanity in general. Science has not even formulated the biosocial destiny of mankind as a whole, and until this is attempted human behavior will seem to possess that spontaneity and freedom which has been designated as purposive, but which has biophysical and biosocial antecedents just as immutable as the gravitational forces which the physicist calculates from the rain-drop's trajectory.

Purposive Behavior

The responses made by the individual can be regarded as independent units only in a relative sense. Actually every action is related to every other action and the life history of the individual is constantly changing with respect to (1) the innate-acquired compromise in behavior, (2) the social status, (3) the character of subsequent behavior. Every action is the effect of all the preceding actions and a partial cause of all the actions which follow. The indi-

vidual not only responds to stimuli as they appear but also in conformity with a biosocial plan or order which depends on his inheritance, training, and the environment in which he moves. This life plan is made up of such partial plans as securing an education, building a house, organizing a golf club, establishing an annuity, etc. The individual does not develop these spontaneously. They develop out of his biosocial environment and represent traditional, educational, and the economic factors under which social organization has developed.

If we consider for instance a physician's activity as representing a given social status, his actions may be grouped into categories having about the same order and sequence for all physicians and which may be designated as the *life of a physician.* A student training himself to be a physician learns this order through the life history of his father, an uncle, characters in literature, medical curricula, etc. When he claims to foresee or anticipate the consequences of his present activities this means that he is able to approximately classify his present and past activity with respect to its place in such a special series. Foreseeing is thus a form of behavior and means that the individual and other members of his social group have learned the order of sequence of many stimulus-response systems and are able, from a limited response sequence, to indicate the probable stimulus-

response terminus and thus establish the social status both present and future of the individual. We have specified the life-history sequence of a physician. There are many other such series which have been fairly well conventionalized. We speak of the kindergarten pupil, the elementary pupil, the secondary school pupil, the college freshman, the graduate student, the business man, the doctor, the university professor, the engineer, the preacher, the criminal, the artist, the house-wife, etc. The separate responses out of which these series are built up have an ontogenetic, phylogenetic and social history that is very complex, but every individual can to some extent designate the place of his own actions and those of others in such conventionalized behavior series. He is not able to do this very well, and as a consequence the prediction of human behavior is not very accurate, but no scientific classifications which actually enumerate the essential actions in such a series as that represented by a particular vocation have yet been established. A beginning is being made in what we call special curricula and professional training.

The reason why our so-called wants, desires, and purposes seem to be such spontaneous affairs and apparently independent of environment and past training, is due to the fact that the adult is unable to discriminate the various behavior series to which

his own actions belong. Stimulating conditions occur which release behavior belonging to conflicting categories, and while the conflict lasts it seems that a push either one way or the other is necessary to release any behavior at all. This push seems to come from some unknown force from within. That the final action even though it seems to hang by a hair is only the mechanical resultant of all the biophysical and biosocial causes that have acted on the sensorimotor mechanism, cannot be demonstrated until it will actually be possible to trace backwards the biophysical and biosocial antecedents of fairly complex actions.

Purpose or purposive behavior is the name for the fact that in addition to multiplicity and variety in the responses of the individual there are also inter-organizations of the various response systems that conform to traditional or conventionalized sequences. The sequences form parts of longer behavior life history series. The terminal responses of the sequences belong to individual or biosocial categories and are designated as the purpose or aim of the antecedent activities.

Analysis of Purposive Behavior

While from the wider behavioristic standpoint all behavior is purposive in the sense that it forms a part of the total behavior life history complex, it is

possible to group together various activities of the individual so they will conform more or less closely to the traditional meaning of the term purposive. As stages in this grouping we may designate:

1. A stimulating condition which releases many forms of implicit responses derived from previous responses to similar stimulating conditions.

2. An interval of implicit activity that represents some specific behavior series in the repertory of the individual.

3. Changes in the order in which the implicit reactions occur to form a new combination with a new terminal response.

4. The new order, in which the responses are arranged as temporal series, may show varying degrees of completeness. The earlier responses are the so-called *desires*, the intermediate responses the so-called *means toward ends*, and the terminal responses, the so-called *purpose*.

VOLITION

THE NATURE OF VOLUNTARY BEHAVIOR—THE ANALYSIS OF VOLUNTARY BEHAVIOR—TYPES OF VOLUNTARY BEHAVIOR: *Extraversion, Introversion, Normal*—GENERAL REMARKS.

THE NATURE OF VOLUNTARY BEHAVIOR

The popular conception of volition or will assumes: (1) that the individual does not react to all

the stimulating conditions which surround him; (2) that he *selects* those stimuli to which he will react; (3) that he in some spontaneous manner determines what the character of the response shall be; (4) that he is able to foresee the biosocial effect of any action; (5) that his selection of the behavior series is governed by some teleological reference to his own welfare.

A behavioristic analysis of so-called voluntary behavior exhibits the fact that at times: (a) the *stimulating conditions* acting on the individual seem equally potent to release a number of alternative, and often contradictory implicit and overt actions derived from previous reactions to similar stimulating conditions; (b) *an interval* during which the various implicit reactions vary in duration and intensity (the so-called period of deliberation and the feeling of effort). After a longer or shorter time the contradictory implicit responses disappear and there remains a non-contradictory implicit reaction group (the so-called choice) which may correspond with (foresee or anticipate) the terminal overt behavior; (c) if no changes in the stimulating conditions occur the *terminal* behavior will be released and so-called voluntary behavior is completed. These three stages will be considered more in detail.

The Analysis of Voluntary Behavior

The Stimulating Conditions—Of the many stimulating conditions that act on the individual only a few release immediate specific responses. When the responses are delayed this may be the result of the three sets of conditions: (1) the stimulating condition may be new and without an acquired response; (2) the stimulating condition may lead to reactions which are contradictory, either because antagonistic muscle groups are innervated or because the reactions themselves were not acquired as a unified behavior series; (3) the stimulating conditions may change so rapidly that no unified action is completed before a stimulating condition appears which releases another and usually contradictory course of action. In typical voluntary behavior the earlier responses do not pass the implicit stage, and while this is occurring there is an interval of overt inactivity.

The Interval—The period of deliberation is the interval between the stimulating conditions and the terminal behavior, during which several implicit reaction series are running their course. They are the residual effects of at one time overt reactions. The later implicit reactions represent overt reactions which have not been reduced to the implicit form to as great an extent as the older reactions. There is always thus the probability that the recent overt reactions are more likely to be repeated and to

become the terminal behavior to the so-called voluntary stimulus. They may never occur, of course, because the stimulating conditions themselves may change. They are, however, the actions which the individual *foresees* and which he describes as his choice. To *foresee* an action only means that in the past a similar reaction series has had a certain position in a particular behavior series. If at any particular moment, any reaction in this series occurs implicitly, it will be followed by the implicit effects of the complete original overt series. The behavior of the individual at the particular moment may be a partial repetition of the original overt series. That part which has not yet been repeated overtly will have been repeated implicitly and this is what is meant by *foreseeing* future behavior. From the standpoint of the behaviorist, *to foresee* is an illusion; all implicit behavior can be nothing but *reminiscent*. The individual is only *reviewing* a past behavior series which somewhat resembles the series now in progress and which is only partially completed. The period of deliberation is thus only that period in which the stimulus is releasing implicit reactions more or less contradictory in character. The "chosen" or "selected" alternative is merely the last implicit form which precedes the terminal behavior. The character of this final or "chosen" behavior depends upon the past habits

of the individual and the way in which these habits have modified each other, and not upon some spontaneous psychical or mental activity. The implicit reactions which were contradictory with respect to the terminal behavior, may in the light of subsequent developments, have represented responses that would have been more adequate than the so-called "chosen" behavior. This means only that past habits may occasionally be more effective in new situations than recent habits. This is usually expressed by the phrase *changing one's mind*, or if the terminal behavior has actually occurred, by the behavior category best described by the term "remorse."

During the interval in which the implicit reactions are occurring, the nervous processes are going to contradictory or antagonistic muscle groups, and releasing incipient movements that are strong enough to stimulate kinesthetic and organic receptors which in turn release postural muscle antagonisms that require a considerable amount of muscular energy on account of the fact that both flexor and extensor muscles are innervated. All of this changes the biophysical composition of the body in a specific manner and since the receptors and effectors cannot be localized and given an anatomical or a physiological locus the resultant effect only is discriminated as the so-called *feeling of effort*. This feeling of effort has, of course, no influence on the final behavior that oc-

curs. From the popular standpoint the effort seems to be a force which sits in judgment on the various alternative responses and then selects the one which best seems to fit the total circumstances. From the standpoint of behavior, effort is only a series of antagonistic kinesthetic and organic reactions.

The Terminal Behavior—The type of activity that follows after the interval of so-called deliberation, will depend upon (1) the nature of the original stimulating conditions, (2) the inherited endowment of the individual, (3) the responses that he has acquired, and (4) upon the nature of the stimuli which follow the original stimulating conditions. The terminal behavior in volition is the ordinary activity in every-day life. It is terminal only with respect to its place in the specific so-called voluntary series.

Types of Voluntary Behavior

Different individuals, and the same individual at different times, differ greatly with respect to the adequacy and promptness with which the terminal response in a voluntary series occurs after stimulation. This relationship between stimulation and action, or the relative duration of the interval for different individuals is described as introversion or extraversion.[1]

Extraversion—In this type of individual the stim-

[1] James characterizes these types as the impulsive and the obstructed types.

ulus releases relatively few alternative implicit reactions. One of these soon reaches a functioning intensity and the terminal behavior is then prompt and energetic. This is the individual *that gets things done* even though it may later turn out that the things are poorly done. The extravert according to a compilation of views published by Freyd ('24) is defined as "An individual in whom exists a diminution of the thought process in relation to directly observable social behavior, with an accompanying tendency to make social contacts" p. 75). From the sensori-motor standpoint this type probably denotes limited implicit behavior. This may result from a limited behavior versatility or from hypersensitivity and high tonicity that releases the overt action which corresponds to whatever implicit reaction is occurring. The behavior of the extravert in whom the inherited sensori-motor equipment is poor, or in whom training has been deficient, is usually characterized as *thoughtless*. This implies that the overt behavior is too simple for the complex character of the social organization that prevails.

Introversion—By Freyd this type is defined as "An individual in whom exists an exaggeration of the thought processes in relation to directly observable social behavior, with an accompanying tendency to withdraw from social contacts" p. 74). From the sensori-motor standpoint the stimulating conditions

release *many* alternative and contradictory implicit reactions but the implicit reactions become cyclic in character and remain relatively weak and of equal strength, without becoming overt. Final overt action is delayed, hesitant, and often irrelevant. This type of behavior is popularly characterized as an inability to *make up one's mind.* There is a wealth of implicit behavior with inadequate biosocial terminal action. Under these conditions the individual is always wondering *what is the right thing to do*, without ever doing anything. Instead of the alternative implicit reactions becoming fewer and showing greater differences in intensity they become more numerous and more uniform in intensity so that a *choice* does not occur.

Normal Type—In this type of individual the stimulating conditions release *many* contradictory implicit reactions. After an interval one series becomes stronger, the contradictory character of the group grows less, and the terminal behavior is at first delayed, but when it starts it is prompt and energetic, and corresponds to the implicit series that finally became the strongest. It is in this sense that the final implicit response may be said to have anticipated the final overt behavior. The normal type is an intermediate type between the introverted and the extraverted types. Speaking generally the extravert *does not think enough and responds too soon, the intro-*

vert thinks too much and responds too slowly. In the normal type the terminal behavior is delayed until the most effective implicit reactions have occurred and thus prepared the sensori-motor mechanism so that the biosocially most effective terminal behavior is released. While the introverted and extraverted types of behavior are clear-cut as limits, this does not imply that all individuals fall into one or the other category. The individual may be predominantly introverted for one form of stimulation and extraverted for another. Under forms of stimulation that release emotional reactions the individual is always more extraverted than under normal conditions.

General Remarks

From the behavioristic standpoint strengthening of the will means only that the sensori-motor system of the individual is being so modified that the percentage of socially acceptable actions is becoming greater. Anticipatory behavior is reminiscent behavior and indicates the type of the responses that have already been established. Usually they are so fragmentary and reduced that the individual cannot discriminate how they occurred or where they originated. The *freedom of the will* is an illusion that is based upon the inability to discriminate the origin of implicit reactions. To regard voluntary behavior or volition as a category of human behavior seems

hardly worth while. Volition has a social significance only if we assume the existence of some psychical or mental selecting agency. If this is denied voluntary behavior is no different from any other form of behavior. Strengthening the will from the behavioristic standpoint thus only means that the individual is acquiring a more effective set of biosocial habits. This, however, is occurring throughout the life of the individual and particularly under educational conditions.

MOTIVATION AND EMOTION

CHAPTER XVI

MOTIVATION AND EMOTION

MOTIVATION

THE NATURE OF MOTIVATED BEHAVIOR—BEHAVIOR ANALYSIS IN MOTIVATION.

THE NATURE OF MOTIVATED BEHAVIOR

The popular conception of motivated behavior assumes that (1) the individual is acted upon by various stimuli and as a result of these stimuli he (2) selects an ideal, and this ideal has (3) a selective capacity through which the subsequent activities are controlled by (4) a non-material force (the motive) so that (5) a specific end result which has been foreseen or anticipated will be achieved. The scientific problem is that of showing how an *ideal* may act as a *motive* in controlling movements.

The behavioristic conception of motivated behavior reduces itself to the following biophysical and biosocial conditions: (a) a complex stimulating condition, which (b) releases alternative implicit behavior series, (c) the intensification of one specific series which is an essential antecedent of (d) the biosocial category that has been intensified. To illustrate: A boy who is just entering high-school intends, as we say, to become an engineer. The complex

stimulating conditions (a) which are the antecedents of this intention may be the reading of the biography of a successful engineer, a talk with an uncle who is already a successful engineer, the actions of a school-mate who is going to an engineering college, a statement of the salaries of engineers, etc. The alternative responses (b) that may occur may be implicit responses remaining after having read a description of the installation of a super-power plant, or after having attended an engineer's reunion. The intensification (c) of one of these, results in details which may indicate the type of engineering. The terminal behavior series (d) is usually of a much more socialized type than those which form the terminal responses to desire and purpose, and in this instance would be represented by the different kinds of engineering. Whether or not the boy does become a successful engineer will depend upon his native endowments and upon his subsequent environment and training.

As a behavioristic problem, motivation presents itself as an analysis of the essential activities in specific life histories. For the successful engineer the activities may approximate the following: each engineer will have had certain courses in mathematics, in shopwork, in history, in language; each will have written a thesis on some engineering topic; some

will have been elected to Sigma Xi or to an honorary engineering society.

Many of the intermediate activities will not be similar. Thus one engineer may be a Catholic, another a Methodist, another have no religious affiliations; one engineer may be a golf enthusiast, another an expert at cards, another a music lover; none of the successful engineers will be drunkards, thieves, or gamblers. Continuing in this manner, the behavior of the engineers before they become successful will show certain uniformities. Some of the activities will be essential in the sense that if they had not occurred the individual would not have become a successful engineer. Also, not all the activities that were essential for one individual, are essential for another. While there are essential antecedent activities common to all successful engineers (work in mathematics, for instance) for each individual there are specific activities which must be individually considered.

Behavior Analysis of Motivation

The so-called motive is the behavior which is arbitrarily designated as the end result. Developing so-called motives is a process of presenting those stimuli that are most effective (considering the endowments of the individual) for establishing the response series that will have as its end result the form

of behavior that has been selected. In the widest sense, developing motives is the presentation of the effective stimuli for establishing a socially and personally acceptable behavior life history. At present the practical approach to the problem of proper motivation requires the following:

1. A record of the inherited and acquired endowment of the individual.

2. The development of some hypothetical behavior series causally interrelated and terminating in the behavior category to be established. Copy-book phrases, mottoes, survey courses, popular lectures, are used a great deal, but no scientific attempt has been made to determine their potency in actually modifying behavior.

3. The formulation of a number of behavior life-histories of actual or hypothetical individuals which represent the many alternative behavior possibilities that improve the biosocial conditions under which civilization develops. This method is now used in teaching morality, but again, its actual effectiveness is unknown.

Effective motivation is the problem of presenting those stimuli which are most effective in maintaining the preparatory activities that are essential for the formation of a given biosocial status. This is an experimental problem which is just being started.

THE EMOTIONS

Emotional Behavior as Preparatory Behavior—Genesis of Emotional Behavior—Biosocial Changes in the Emotional Reaction—Emotional Instability—The Emotional Reaction in Everyday Life—Emotional Reactions as Esthetic Reactions—The Esthetic Response.

Emotional Behavior as Preparatory Behavior

The average man during twenty-four hours releases an energy equivalent of about 3000 calories. Dividing the 24-hour day into three periods of eight hours each, eight hours sleep consume 600 calories, eight hours semi-active 750 calories, eight hours work 1540 calories. There are of course great variations between individuals and in the nature of the work done. Neither is the rate at which the energy is released at all uniform, especially during the waking hours. For short periods as in lifting a heavy load, climbing a long flight of stairs, a short fast sprint, the energy released may be at the rate of 5000 calories per hour.

In general the statement may be made that every reaction requires a specific expenditure of energy which varies greatly for different stimulating conditions. Under the normal conditions the reserve food materials in the nervous and muscular tissues is not much above that required for the demands of

a basal metabolism rate of about 100 calories per hour. This means that nerve cells and muscle fibers do not carry any considerable amount of available food material and if they are subjected to extremes of function the available reserve is soon used up and must be renewed. This is done through the blood stream which carries a constant amount of food material in the form of glucose. As this is absorbed by the tissues it is restored to the blood by the conversion of the glycogen in the liver to sugar. If for any reason a group of muscles is required to function strongly, the release of glycogen from the liver must be increased greatly beyond the normal output to make up for the depletion of the food supply in the muscles. The amount of blood sugar (glucose) is rather constant, between .12 and .15 per cent, no matter what the rate of absorption by strongly functioning muscle fibers may be. Since the energy output during the waking hours varies between wide limits and for varying intervals, the absorption rate of the sugar from the blood stream also varies greatly. To keep the sugar content of the blood as constant as it has actually been found to be, requires a delicate regulating mechanism by which the liver glycogen is converted into glucose and released into the blood stream at approximately the same rate at which it is absorbed and converted into energy by the muscles.

This regulating mechanism is made up of the endocrine glands or the glands of internal secretion. When adrenalin, a secretion from the adrenal and suprarenal bodies is injected into the blood stream it acts as a stimulus to the liver cells so that the stored glycogen is converted and released into the blood stream where it is transported to the muscles that are working, and absorbed by them before their reserve food supply is used up, a lack of which would stop their function. However, the release of adrenalin also produces other secondary effects, the dilatation of the pupils, increased blood pressure, secretion of saliva, erection of hairs, etc. Whether these are essential reactions for the proper functioning of the nervous system and muscles, is not definitely known. However, these reactions also stimulate adjacent kinesthetic and organic receptors which in turn produce changes in respiration, pulse rate, vaso-constriction or dilatation. Groupings of these changes produce the complex reactions known as the emotions of fear, anger, joy, sorrow, shame, etc. Other secretions which have a regulatory function are the thyroid and parathyroid, the pituitary body, the spleen, the sex glands. The whole system of endocrine glands of internal secretion may be regarded as a regulating mechanism by which the nervous and muscular tissue is being prepared to meet the energy demands of certain stimulating conditions. Some-

times the energy demands upon the muscles are enormously augmented as in escaping from danger (fear and flight). At other times the energy demands may be diminished below the normal, as in grief and sorrow. These compensations must be rather prompt because the reserve food supply in the muscle fibers and nerve tissue is not very great at any time.

The so-called *expressions of the emotions* as in fear or sorrow, seem to be only secondary reactions (phylogenetically related to some phase of the internal regulating mechanism) which now seem to have little biosocial utility under the reduced activity of civilized life.

Genesis of Emotional Behavior

If all the emotional reactions are regulatory mechanisms typified by the blood sugar mechanism, then they would be of greatest importance under primitive conditions where the fluctuations in energy expenditure vary much more than under civilized conditions. One of the effects of civilization is to eliminate the conditions which require highly variable outputs of energy. Under adequate protection and optimum food and shelter, the expenditure of energy is much more uniform throughout the twenty-four hours. Even the purely muscular variations as climbing stairs and running have been

largely eliminated by the elevator and power transportation.

Biosocial Changes in the Emotional Reaction

The neural connections between the stimulating conditions and the energy regulating mechanisms are largely inherited. However, under civilized conditions both the stimuli that release the overt response and the responses themselves have been changed. The fighting response is changed very early in life. An observation of school fights reveals this very clearly. Taking away a toy or other object usually releases a fighting response but the response itself is seldom that of the primitive reaction of biting, slashing, or scratching. It may vary from sticking out the tongue, crying, telling teacher or parent, slander, to hitting a smaller brother or sister of the offender. In the adult the change is still greater. The primitive overt fighting reaction seldom occurs, and has been socialized into such forms as calling a policeman, avoiding future encounters, bringing suit in court, etc. All of these responses require much less energy than the original fighting reactions. However, the part of the instinct which regulates the internal secretions may still prepare for large energy variations. The implicit reactions may be almost as strong, and the secretions much too strong to meet

the demands of the civilized overt behavior. As a result the secretions remain in the blood stream for a longer period than usual and in the excessive amounts in which they occur they produce secondary stimulating conditions such as glycosuria which interferes with the normal or socialized reaction to the stimulus. Consequently even the socially acceptable response to insult, *the act of turning the other cheek*, seldom takes place in the copy book manner. This is, of course, to be expected. While the child is *learning* the proper biosocial response to an insult, no internal secretions are present. However, insults as they occur in ordinary life do not occur under copy-book conditions; internal secretions *are* released. Consequently the most recently acquired biosocial response is delayed for a time during which earlier, more instinctive responses such as retaliation, denial, righteous indignation, etc., occur. After a time the internal secretions grow weaker, the more approved form of response presents itself and the individual may then *conclude that he has made a fool of himself*.

The analysis of the inherited response patterns has absorbed the interest of many investigators and the classifications of the emotions and instincts are numerous. Under civilization the stimulating conditions and the reactions that are released differ from those that occur under primitive conditions but they

are not sufficiently up to date to be adequate for the prevailing social responses. Hence the internal regulating mechanism may actually produce neural conditions which interfere with the adequate biosocial response. It is in this sense that an emotional reaction which might have been very valuable under primitive conditions may actually be harmful under socialized conditions. Under civilized conditions emotional reactions are usually wrong reactions because they represent types of responses that are no longer adequate.

The behavioristic analysis of the so-called emotional reaction as it occurs under present conditions, should be (1) to attempt to isolate the new stimulating conditions that release a given internal regulating mechanism and (2) to determine the character of the responses which are released. Rage, anger, love, grief, under the highly socialized modern conditions are entirely different forms of behavior than they were at the dawn of civilization. In fact under modern conditions they may actually be detrimental. However, the education of internal regulative mechanisms seems to be more difficult than the education of peripheral sensori-motor mechanisms. A large proportion of the population is *emotionally unstable* and nearly every individual during certain periods or moments loses *control of himself*.

Emotional Instability

Under normal conditions the internal regulating mechanism augments or depresses the rate of the energy expenditure so that the character and energy of the response will conform with the socialized adjustments to the stimulating conditions. In a given individual the functioning of this regulating mechanism may be poorly co-ordinated with other biosocial activities. For instance, a stimulating condition which would not augment the secretory conditions in one individual, may in another person produce strong non-socialized responses. Many of the crimes against sex belong to this class. On the other hand, a stimulus which in one individual releases intensive reactions such as those released by evidence of flagrant dishonesty, insult, etc., may leave another person quite impassive. The emotionally unstable individual is one in whom the internal regulating mechanism does not prepare adequately for the neural and muscular energy compensations that are regarded as normal. The emotionally unstable individual either over or under-reacts.

The Emotional Reactions in Every Day Life

Under the present civilized conditions of living, the emotional responses probably have little value. The internal regulatory system produces inhibitions

and intensifications which interfere with the development of those behavior series leading to a more effective co-operation between individuals. As a rule the so-called mistakes in life are as much due to emotional conditions as to the lack of education. The plans made and the things done under fear and anger, are usually the responses that are regretted afterwards. Instead of regarding the emotions as effective driving forces, it would be more correct to call them worn-out habits.

Emotional Reactions as Esthetic Reactions

With the more uniform expenditure of muscular energy under civilization, the internal regulating mechanism does not function between such extreme limits as under primitive conditions, and as a result the emotional responses are apparently becoming less intensive. However, a slight augmentation of the metabolic rate increases the bodily tonus. Intensive overt reactions do not occur and the waste products from excessive function are not liberated into the blood stream to create disturbing conditions which interfere with the reactions to biosocial stimuli. The drama, for instance is made up of stimulating conditions which release internal secretions but not nearly in as great an amount as if the situation were real. However, some of the reactions as laughing or cry-

ing *are* released but the endocrine secretions have been so reduced that only a more favorable metabolic condition results. Digestion may be augmented, respiratory and vaso-motor conditions may be more favorable, the biosocial response to the drama (criticism) is more active and supplements the routine activities, thus adding variety to behavior. This condition is at the basis of so-called esthetic appreciation.

Music as a stimulus may function in the same way and has probably done so even under primitive conditions. Not all esthetic appreciation is of this simple type but in those instances in which an esthetic reaction has been developed for stimuli which at one time led to violent responses such as actual fighting and murder, we have developed a condition in which violent stimuli do *not* release violent reactions, but rather mild socialized reactions, although the internal regulatory mechanism still produces a "thrill." The normal intensive reactions do not take place and hence the energy output is low and no waste products are eliminated through excessive functioning. The metabolic level is raised, the routine responses are supplemented by variety in behavior. From the esthetic responses of the emotional type we pass by degrees to the esthetic responses in which the internal stimuli are replaced by peripheral sensory elements

as in symmetry, color and form combination, consonance, rhythm, etc.

The Esthetic Response

Suppose a potter to have made a large number of jars for the purely utilitarian purpose of holding liquid. Suppose his stock was growing larger and that the need for *efficiency* in production was not pressing. Under these conditions of leisurely production the potter could *play* at his work and produce variations in shape without affecting the utility or the cost of the jars. Suppose he produces ten different shapes or models and an excess supply of each model. In selling the jars all for the same price, some models would sell more rapidly than others and some perhaps not at all. If the customer were asked why he selected a particular model he would probably describe it as more *pleasing*, more *beautiful*, more *symmetrical*. In view of the fact that not all the customers selected the same model, the beauty could not be limited to the jar but must also include some sensori-motor condition in the buyer. In an attempt to determine the factors involved in the esthetic response, suppose we consider the situation in which two of the customers of approximately equal sensori-motor antecedents select the same model but that only one jar of this model is left. One customer is obliged to accept a second

choice. In what way will the behavior of these customers toward their jars differ? The customer who secured first choice will probably handle his jar more carefully, will complain less about the price, will insist that it be delivered promptly, or may even carry it home himself. As an object of display he will place it under more favorable conditions, will caution the children to be careful and not break it, and if it is broken the reprimands will be more severe. The customer who was obliged to accept second choice, will show less energy in all these responses.

Biosocially the esthetic appreciation is a more intensive and more detailed responsiveness to one of the alternative forms of jars. This special responsiveness may have developed as follows: Assume that the customer has used jars of this type in many ways and that the jar-using activity is an important link in his daily routine of supplying the family with water. Within this larger behavior series the jar-handling activity would vary according to changing sensory conditions with different jars, changes in lighting, position, back-ground, the personal variations of the individual, the variability in family routine, etc. The *total* sensory conditions will hardly be identical in any two instances. Out of this very complex system of jar-using responses there gradually emerges, however, a resultant or unified response system that

is much more general than any one particular response. Mechanically, this process may be illustrated by the composite photographs of racial types in which many faces are exposed for a short period on the same negative, and when this is developed and printed, it shows a composite of the facial characters of the race. Suppose the sensori-motor pattern of the jar-using activities to have undergone a similar process of superposition. There will develop a *specific* sensory pattern which will release the jar-handling responses more intensively than other sensory patterns. The individual's responses to the different models at the potter's will manifest this generalized effect by his more intensive response to one of the models that corresponds to this generalized type. The final or composite pattern will not be the same for all individuals who use jars in the way described. Variations in inheritance, differences in family management and many other variables will produce differences in the final pattern but there will be a *universal* element which is a *master composite* of the individual composites. No single individual possesses this universal sensory composite but its social character is revealed by the fact that our potter sells a greater number of some of the models than he does of others, and by the fact that some of the models are *not* sold as long as other models are avail-

able. This behavior condition is at the basis of the esthetic response.

The passive character of the esthetic response is largely due to the implicit nature of the reactions. The totality of the stimulating conditions, the shop, the home environment, particularly at moments of leisure, do not release manipulating reactions so much as the internal organic effector processes which occurred during those conditions in which the jar-using response was most intensive, as for instance while the user was being praised for his skill or dexterity. This accounts for the so-called pleasant affective-tone.

The essential condition for the development of the esthetic reaction seems to be a *composite* sensorimotor condition that is independent of the nature of the specific sense-organs or effectors. The different senses involved in the appreciation of music, plastic art, painting, drama, literature, etc., seem to have no specific effect on the esthetic appreciation.

At this time through good music, good literature, good pictures, the *utility* or the *play* method is much shortened. Esthetic appreciation is rapidly developed by presenting to the individual *directly* those types of stimuli which will produce the *universal* response. This is called art education. The types of objects that will release the esthetic responses depend to a large extent upon inheritance but the extent to which they may be expanded and refined depends largely

upon the number of opportunities for reacting, the amount of leisure available, and the extent of training.

The essential sensori-motor antecedents of the esthetic reaction have received practically no attention. The extreme variability of the reaction from individual to individual has made its study difficult and the method of approach which held esthetic appreciation to be a psychical condition in which an esthetic faculty was present, obscured the sensori-motor and biosocial factors.

POSTULATES, MEASUREMENT, ETHICS

CHAPTER XVII

POSTULATES, MEASUREMENT, ETHICS

ONE SET OF POSTULATES FOR A BEHAVIORISTIC PSYCHOLOGY [1]

WHY should the fundamental principles of psychology be reformulated?

PHENOMENOLOGICAL AMBIGUITY

The categories mind, consciousness, awareness, purpose, volition, sensation, image, feeling, etc., have failed to establish the degree of phenomenological specificity which is essential for a uniform program of scientific investigation. If a group of psychologists were asked to define, describe, and explain what they understand by the term consciousness or mental, the reports would show such divergences that a scientific quantification would be impossible. This lack of agreement is increasing rather than decreasing.

DUALISM *versus* MONISM

The antecedents of traditional psychological phenomena cannot be compared with, and causally related to, the ontogenetic, phylogenetic, and evolu-

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tionary antecedents of natural science phenomena. If we ask, what are the evolutionary antecedents of the mental states of redness, of sourness, of pleasantness, and then postulate some measurable physiological condition as a correlate to the mental state, we actually reduce mental evolution to physiological evolution, thus raising the question as to the scientific expediency of assuming a mental series at all. To explain human achievement we do not need both a mental and a physical system.

Mental Processes Are Not the Antecedents of Social Achievement

The traditional psychological categories have not been integrated into the phenomenological series of events and objects which constitute human achievement and civilization as represented by the educational, vocational, administrative, recreational, and personal activities of the individual, or as represented by the corresponding social institutions. Even supposing it to be possible to secure a comprehensive record and description of the so-called mental states or mental processes of any given individual from birth to death, such a record is not a record of the antecedents of those actions nor of the social effects of those actions which represent individual or social achievement.

The Conditions for a Reformulation

I assume that a reformulation of the psychological postulates is justified if it achieves a greater measure of agreement as to their phenomenological limits; if it establishes a methodology which replaces the mind-body dualism by a systematic monism based on the assumptions of the physical sciences; and if the psychological elements that are adopted, form the antecedents and components of individual conduct or behavior, and of social achievement or civilization. The problem of reformulation is not so much one of the accuracy of observation and measurement, as it is one of classification.

The Postulates

In the set of postulates which follow, human behavior and social achievement are assumed to be forms of motion. It is not expected that there will be complete agreement on the propositions which are given in support of these assumptions, but it is expected that the phenomenological limits to which these propositions refer can be more uniformly established than can correlative propositions referring to psychical or mental phenomena. In other words, it is easier to agree on the properties of an electron or the nature of motion than on the properties of a mental state or process.

1. Electrons and Protons

The universe is the sum of the movements of its fundamental elements, the electrons and protons. The electron is defined as the smallest unit of negative electricity and the *mobile* constituent of the atom. The proton is defined as the smallest unit of positive electricity and the *stable* constituent of the atom.

2. Direction and Rate

If the electrons are regarded as negative in sign and the protons as positive in sign, (a) the *direction* of the movements between electrons and protons conforms to the proposition that unlike signed particles move toward each other, and like signed particles move away from each other; (b) the *rate* of motion being an inverse function of the squares of the distances between the particles.

3. Stability and Form

The operation of the laws of *direction* and *rate* exclude so far as mathematical theory indicates, the possibility of utter condensation, or utter dispersion, or of permanent stability (zero motion) of all the particles. As a result, limited aggregates of electrons and protons form motion groups of varying symmetries, configurations, and degrees of stability, ranging from the relatively simple movements in the neutral hydrogen atom, made up of one

electron and one proton, to that degree of geometrical complexity represented by such aggregates as the earth, planets, stars, and the objects and events occurring on them. Variability in stability and form becomes greater if the mass of the proton is different from that of the electron.

4. Organization

Electron-proton aggregates form various types or categories of interacting dynamic systems which under the present physical conditions on the earth are evolving into organizations of increasing complexity with respect to the number of electron-proton systems involved and with respect to the variety in the forms of the resultant movements.

Free electrons and protons evolve into the atomic type of organization, atoms evolve into the molecular type, molecules into the crystalline type on the one hand and the protoplasmic type on the other. The protoplasms evolve into the unicellular form of organization, and the single cells into the multicellular or organismic type. These in turn evolve into the *compound* multicellular or social type of organization. The totality of these dynamic electron-proton interactions forms the cosmos or the movement continuum.

5. The Individual

The individual is a locus in the movement continuum and the movements within this locus are correlational functions (in the mathematic sense) of all the movements that are occurring in the electron-proton organizations *not* within the locus. More specifically, the human individual is defined as a locus in the movement continuum, constituting a relatively permanent electron-proton aggregate (the atoms, molecules and tissues of the body) interacting with the electron-proton systems not within the body, to form the series of energy interchanges designated as the life processes of nutrition, reproduction, and adjustment.

6. Behavior

The sensori-motor and contractile effects which make up the language mechanism of the individual represents both a stimulus and a response system that exhibits a high degree of correlation with spatially and temporally remote environmental changes, and through which the movements of the individual become relatively independent of the non-language environment. The language mechanism forms the characteristic factor in human behavior.

7. Group Behavior

The totality of the language responses and the language records of a group, approach as a limit the

mathematical conception of unit functional correlation between the linguistic achievements of a group and all the changes that have occurred or are occurring in the movement continuum. In the individual a restricted sensory range, faulty inheritance, restrictive food and shelter activities, wasteful competition, disease, and death, limit this unit correlation to a finite value which is less than that of the group as a whole.

8. Social Organization

The language responses establish the compound multicellular or social type of organization in which there is sensori-motor interchangeability among individuals and within this social organization the individual approaches more closely the hypothetical condition of unlimited sensory range, perpetual youth, immunity against disease, the best inheritance, unlimited physical strength, and unfailing food and shelter resources. The organization as a whole exhibits such a complexity and variety of movements that it approaches more closely than does any individual in it, a hypothetical limit which may be characterized as omnipotent, omnipresent, and omniscient.

9. Civilization

The sensori-motor interchanges among the individuals of a social organization develop institutions such as the industries, transportation, law, science,

medicine, and education, which increase the variety in the behavior of the individual and reduce the limitations imposed by a restricted sensory range, faulty inheritance, restrictive food and shelter activities, disease, and death. Civilization is the cumulative effect of the behavior of the individuals in a group, toward achieving for the individual, unit correlation between the totality of the electron-proton movements outside the locus of movements defined as the individual, and some function (such as the language responses) within the locus.

10. Methodology

The study of human behavior and human achievement is a study of the educational, vocational, administrative, recreational, and personal categories of movements. Any given adult activity is the terminus of two series of antecedents: (a) an ontogenetic series which traces backward through the sensorimotor modifications of the activity to some infantile form of movement; (b) a phylogenetic series which traces backward through the social or institutional modifications of the activity to some primitive social form. The *methods* of study are those of biology, anthropology, social statistics, and a special behavioristic method in which the individual's responses are analyzed into those physiological and social components which form the basis of those movements that

establish the individual's social status in the group of which he is a member, and of those movements which establish the cultural or anthropological status of the group.

THE MEASUREMENT OF HUMAN BEHAVIOR AND OF HUMAN ACHIEVEMENT

Traditional psychology regards man as being controlled by a sort of spirit man within the physical man and that the measurement of human achievement is the measuring of so-called processes as attention, perception, wishes, volitions, images, etc. The behaviorist regards man as a link in the chain of physical processes which make up the universe and with this assumption goes the corollary that the measurements of human behavior and of human achievement are of the same order as physical measurements although the specific equations for individual and social measurements are not yet found in the physics text-books. Because of the fact that time, place, antecedent social conditions, play a much more important role in the changes that take place in man than they do in inorganic changes, new classifications in which man is regarded as a co-operative unit in a relation of sensori-motor interchangeability with all the other members of the community, will need to be invented before the fundamental units of physics, especially as supplemented by recent sta-

tistical methods, will be fruitful. However, this is not unusual. Electro-magnetic phenomena have required the development of special electro-magnetic units, as the volt, ampere, etc., and these are much more useful than the fundamental physical units of the centimeter, gram, second.

Just what special units will be found most useful in the measurement of human accomplishment it is difficult to predict, but it seems to me that three types of units formulated into three types of equations will be adequate. These three are: (1) the measurement of the social status of the individual, (2) the measurement of the independent sensori-motor variables which differentiate one response from another, (3) the measurement of the changes in the social stimulating conditions which represent the anthropological history of the community.

Beginning with the social status we may formulate the equation,

$$(1)\quad S = aE + bV + cA + dR + eP.$$

Let S represent the social status of the individual within his group. The capital letters E, V, A, R, P, represent his attainments in education, vocation, administration, recreation, and whatever special personal accomplishments he may have achieved. The lower case coefficients *a*, *b*, *c*, *d*, *e*, represent individual variations. In actual practice the equation would take the form of a comprehensive record

sheet of a carefully selected group of the individual's activities throughout life. These activities should be selected on an empirical basis and they should represent the resultants of classifications set up by the social and biological sciences.

Each of the five classes is made up of many separate actions or responses which may be represented by the equation,

$$(2) \quad R = \mathrm{a}V_1 + \mathrm{b}V_2 + \mathrm{c}V_3 + \mathrm{n}V_\mathrm{n}$$

Where R is one of the specific responses under E, V, A, R, P, of equation (1), V_1, V_2, V_3, etc., represent independent variables made up of some standardized stimulating condition and the sensori-motor components of the manual, verbal, and visceral effector conditions of the specific response. These variables are of the following type: the accurate measurement of specific abilities such as mathematical, musical, mechanical, perseverance, stability, sociability, alertness, assurance, etc. It seems probable that a list of the twenty variables showing the lowest intercorrelations with each other will be sufficient to completely differentiate and accurately measure any two responses which represent different co-operative values in the social organization.

Human achievement also depends on the past achievements of the progenitors of a community and

this social or historical factor may be represented by equation,

$$(3) \quad H = S_1 + S_2 + S_3 + S_n$$

Where H represents the specific historico-social environment under which the individual develops, as measured by S_1, S_2, S_3, etc., which represent the anthropological or cultural stages in the development of the community.

Analytically equation (3) requires for its solution the qualitative analysis of the social components of the stimulating conditions of the community, tracing backwards to their earliest and most primitive forms. Equation (2) requires the measurement of the independent sensori-motor (neural and physiological) components of the individual also traced backward to their infantile reflexes and instincts. Equation (1) is the integration of (2) and (3) in such a way as to include both the sensori-motor and the social components in a manner which *quantitatively* establishes the individual's social status in the community of which he is a member.

To illustrate: Suppose we consider the specific act of dividing 994/49. Equation (1) assumes that the processes of long division are of sufficient co-operative importance to be given a social rating and that an individual who can perform this behavior has a different social status (in this particular activity) than an individual who can not. Equation (2) re-

solves the sensori-motor components of the act of long division into the proper independent variables. Equation (3) assumes that the effectiveness of the act of long division will depend on the number system which the community has adopted, whether decimal, duodecimal, Arabic, Roman, etc., and that these number systems represent social and historical conditions which may be quite independent of the sensori-motor characteristics of the group. For instance, the difference between the responses to the stimulus 994/49 and the stimulus CMXCIV/XLIX represents a social difference, not necessarily a sensori-motor difference.

These equations differentiate psychology from physiology and neurology in that psychology studies those sensori-motor and social processes as factors which establish the individual's *social status* and not as anatomical or physiological conditions in themselves. Further these equations represent the fundamental postulates upon which the social sciences may be based.

This method of measuring human achievement is opposed to the traditional psychological methods in which the social status is regarded as a function of non-physical faculties such as intelligence, volition, perception, emotion, etc., which generate problems of the type, What are intelligence, volition, perception, etc.? It does not seem to me that these prob-

lems have led anywhere except to a linguistic analysis of what has been included under such terms by the writers who have used them. The result is usually another definition. Under the method I have suggested these terms simply vanish. No attempt is made to classify behavior until it can be measured with a degree of accuracy which conforms to specified degrees of scoring and statistical validity. Under these restrictions the name that shall differentiate a given activity, the origin of the classification, whether from pure or applied psychology, or from other social sciences, or whether the behavior conforms to the traditional classification, is immaterial. The important consideration is that of determining the co-operative effectiveness of the behavior and its importance in establishing the individual's social status with a degree of validity so that all examiners competent to make the measurement will obtain uniform results.

BEHAVIORISTIC ETHICS

An attempt to state simply the type of ethics which would be a corollary of the behavioristic principles outlined in this book might prove instructive. The key-note of this system of ethics lies in developing among all individuals on earth a greater degree of co-operation, to the end that there may be greater sensori-motor interchangeability and a maxi-

mum opportunity for self expression and variety in behavior. This seems implied in the postulates by the fact that the development of physical science has given us better shelter, better transportation, better communication. The development of biological science has given us better food, better bodies, longer life. From social science we have secured better organization, better training, but we have scarcely started on the path toward an equitable distribution among individuals of the benefits of science. For too many of us more machinery means less leisure. The benefits of science are wasted upon a few, at the expense of the many. This is a vestige of the type of ethics in which every individual was regarded as the servant of some superhuman being or force by whom or which his social status was determined at the time of birth.

The development of behavioristic ethics is in the direction of making available for every individual a healthful and decent physical environment during childhood and youth. The educational resources of the nation will be available to all who can use them. These resources will include training in the elements of language, science, civics, and practical ethics; instruction in literature and the fine arts; contact with the personalities and teachings of the founders of the race's culture; and access to any of the special forms of higher instruction and research for which

the individual has acquired the prerequisite training. Education will be regarded as a device for giving a greater range of self-expression and through this development render a greater social service.

The economic organization will be in the direction of giving every individual an opportunity to train himself in a vocation which either allows a maximum of self-expression or in which the conditions of work leave sufficient energy and leisure for an avocation. Under all conditions the normal individual should be able to earn sufficient by his service to society to live decently according to the standards that prevail and if conditions over which he has no control have made it impossible to raise a family in which the children are assured a normal development, society should assume the responsibility for making this possible.

An elimination of economic waste would make it possible to achieve these conditions now, but competition, war, lack of standardization and organization in the distribution of food and shelter make it practically impossible to introduce those scientific methods and experiments by which the relation between population and the earth's natural resources can be deliberately maintained at an optimum level.

The limit toward which the variety of human behavior is approaching may be one in which the indi-

vidual, through a substitutional language mechanism is able to respond differentially to a constantly increasing number of spatially and temporally unlimited electron-proton configurations.

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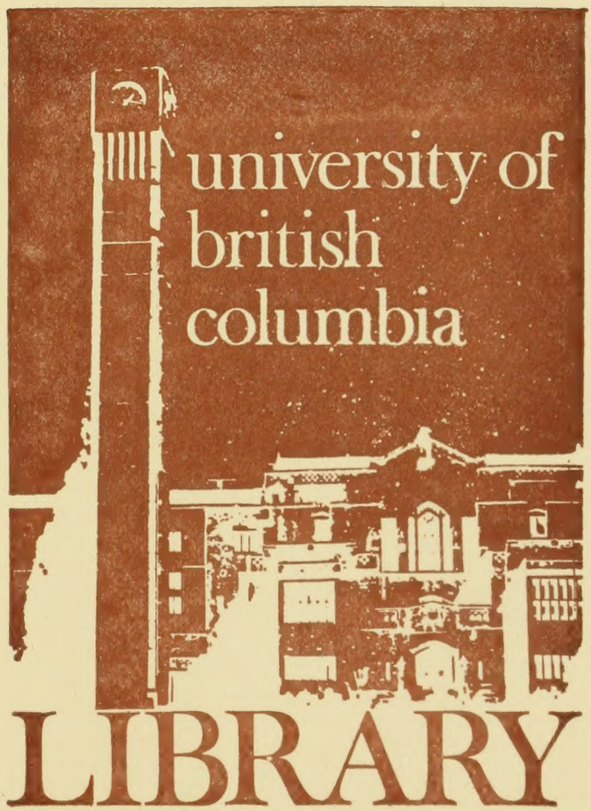
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